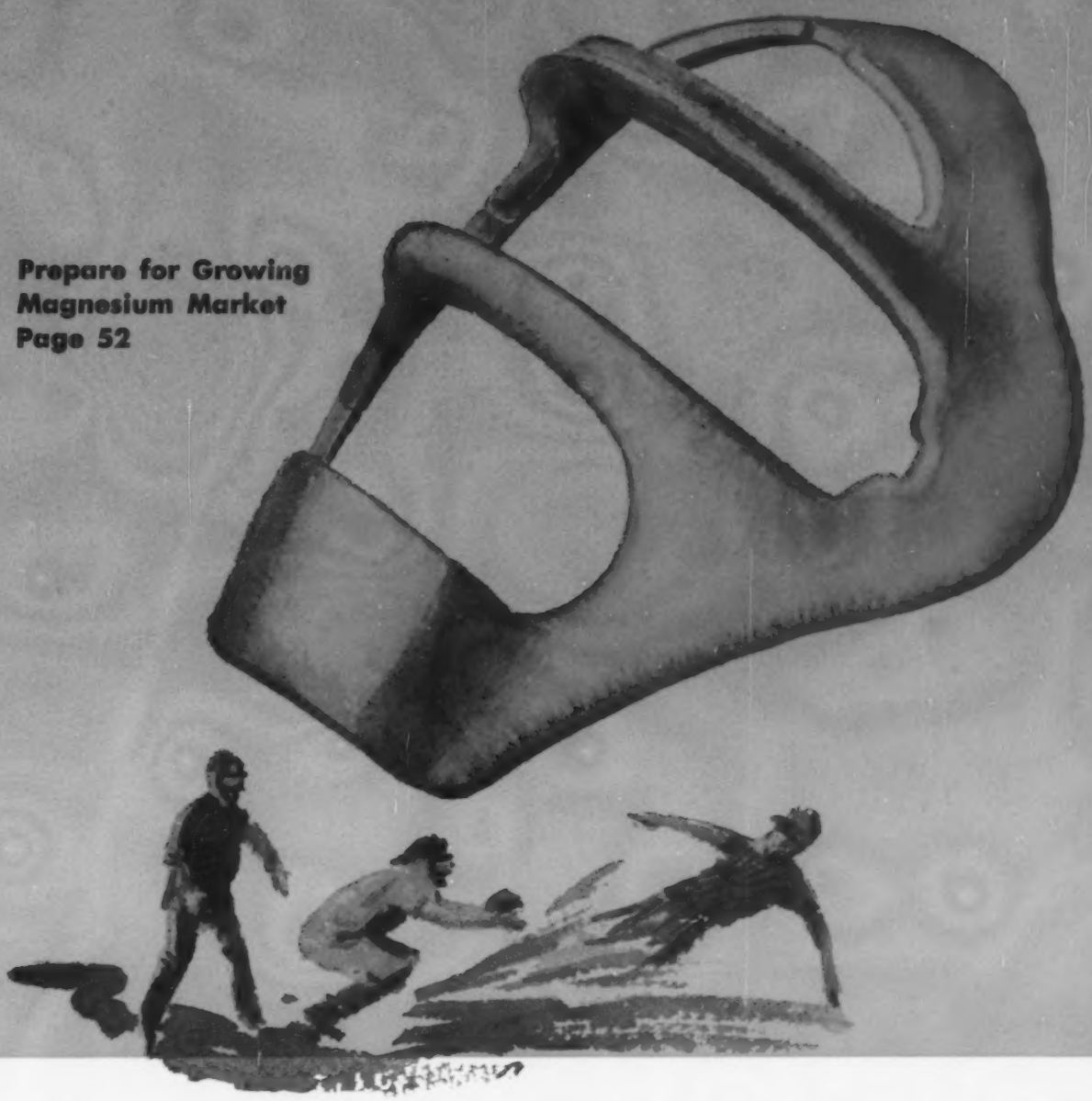
JUNE 1961

modern castings

the technology-for-profit magazine

Prepare for Growing Magnesium Market Page 52



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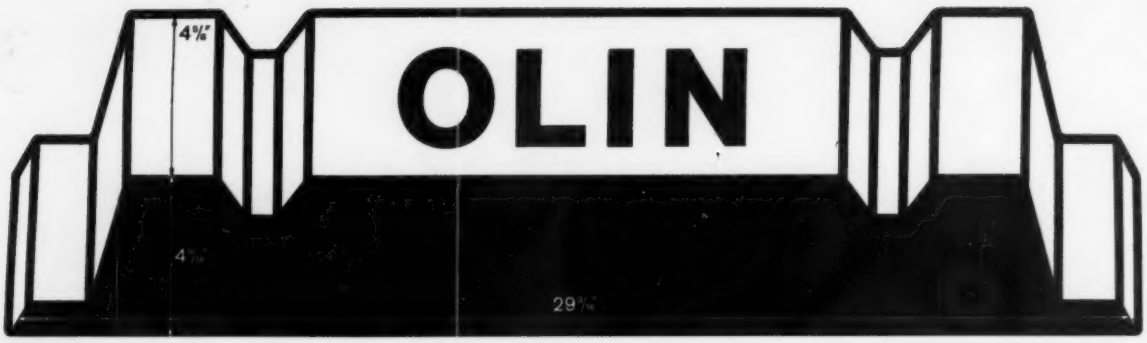
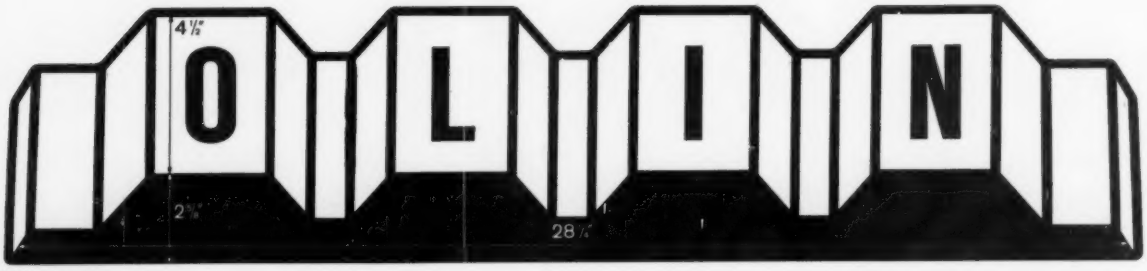


50-lb. ingot



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Circle No. 121, Pages 127-128

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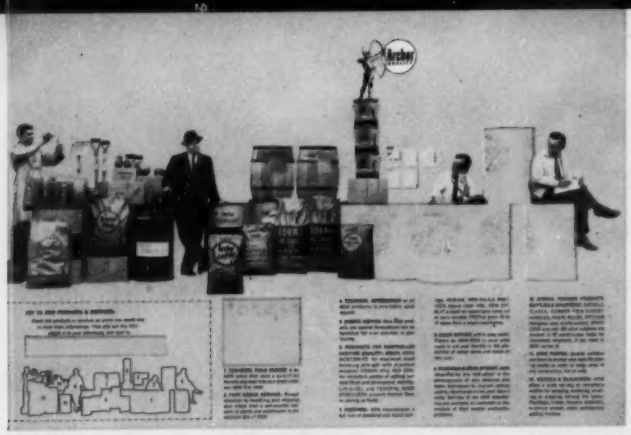

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June 1961 Vol. 39, No. 6

modern castings

metalcasting "technology-for-profit"

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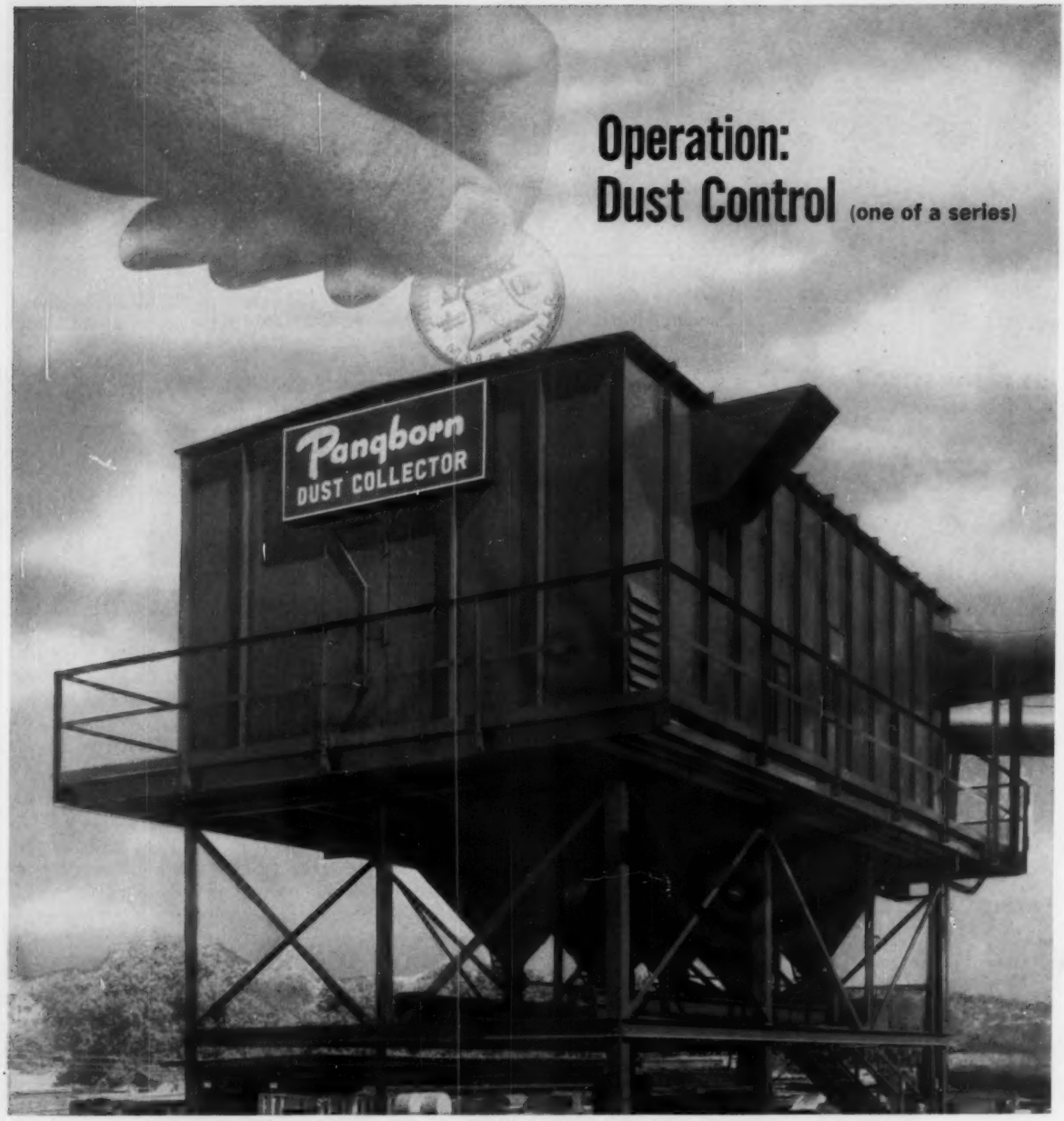

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Let's look at . . .

Another Record Year!

H. E. Green

THIS JUNE ISSUE is an especially newsy one! We have many good things to tell you: about MODERN CASTINGS, about the 65th Castings Congress at San Francisco, and about the state of the metalcasting industry today.

First, let's talk about us! MODERN CASTINGS has just concluded its fiscal year with its *second consecutive all-time high in advertising dollar volume!* This record was made despite the fact that the metalcasting industry has been down for more than 11 months.

We've added many new advertising accounts—a real tribute to you, our readers, as a market for products and services; and a sincere tribute to our dynamic editorial program.

We can report to you that today MODERN CASTINGS is a successful, self-sustaining AFS publishing enterprise.

As you know, advertising pays for more than 80 percent of the cost of producing MODERN CASTINGS—subscription revenue and by-product services the remainder.

This is why we have a top flight industrial magazine, expert and professional in every respect. If we were a mediocre propaganda-type house organ with no advertising, a subscription for the magazine would cost more than $22. Advertising makes it possible to provide leadership editorial material and new technology not obtainable any other way!

But let's get back to the other news:

. . . On pages 43 to 45 is an on-the-spot interpretative report of prime trends and issues today, as gathered at the AFS 65th Castings Congress.

. . . Be sure to read "Focus on the Future" on pages 49 to 51.

. . . There's a special report on the new AFS dues structure on page 98.

. . . An interpretative Photo Report of the Casting Congress at San Francisco begins on page 102.

. . . New Technology starts on page 62. There are six detailed reports. (You'll recall *we were first* with interpretative summaries of 105 technological breakthroughs of 1961 in the May issue.)

. . . Incidentally, the first MODERN CASTINGS Sales Seminar is reported on pages 46 to 48. This is another editorial leadership feature!

The above articles and news stories are all examples of the dynamic leadership MODERN CASTINGS is giving metalcasting today.

As this extremely successful fiscal year comes to an end for MODERN CASTINGS, may we thank you for your participation and suggestions as readers—and may we thank our advertisers for their firm and growing support.

Harold E. Green

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Your foundry . . . *your* casting problem. But helping you is your Ferrocarbo* representative — it's his job to work after hours if need be, to provide whatever technical service and advice is necessary to help you make the best possible casting. He is a practical foundryman — usually a graduate metallurgist — who is expertly qualified to advise in the use of Ferrocarbo briquettes to obtain stronger, denser, more easily machinable castings. He can show you how Ferrocarbo promotes deoxidation — and why Ferrocarbo-treated iron is more fluid at lower temperatures, enabling you to reduce the number of misruns and rejected castings.

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Looking at Business with Modern Castings

TIME TO PLAN

This is a time to seek perspective; to make plans for the next six or seven months. We're at the halfway mark of a "down" year. Business is beginning to pick up. This is not the time to be overly optimistic. Set a moderate course.

How genuine is the current business upturn? It is real, if various indicators are correct. This means the metalcasting industry has gone through a relatively short recession. One fact has been learned: all metalcasters who want to stay in business from here on out must be more adept at studying general business conditions and translating them to their individual operations. Competition is getting more complicated as new technological advances in other industries and in metals, are used.

NEW HIGH FOR DOW-JONES

At this writing, the biggest news in the stock market is that the Dow-Jones industrial average has hit and maintained an all-time high, over 700. This has been followed by gains made by bellwether blue-chip stocks.

Reason for this is continuing good business news where it counts . . . automobile sales . . . steel's quickened operating pace . . . Federal Reserve Board's industrial output index.

Of importance to metalcasters are:

1. New orders and sales of durables are up. These are cues which cause most businessmen to sit up and take notice. New defense contracts are a factor.

2. Machinery, pipelines, and appliances are looking good. Employment in durable goods shows up strong, with a work week that is continuing to lengthen. Construction outlays are larger.

3. Key business leaders are displaying optimism backed up by facts.

(Incidentally, the June issue of MODERN CASTINGS shows a 15 per cent gain in pages, 12% gain in advertising dollars over the previous June 1960. This is another indicator.)

Important to remember is that manufacturing will be following rather than leading the business upturn.

FOREIGN MARKETS EXPAND

Keep your eye on foreign market competition. This may prove troublesome. West European and Japanese plants are expanding their capacities, improving their technology still further. Imports and exports are closer to a standoff now. The U. S. automobile industry may help domestically. Compacts are one reason. The long view for two-car ownership is estimated at

← Circle No. 125, Pages 127-128

11 million by 1965. Compacts should have a big role. This can mean much to metalcasters.

What about some specifics in metalcasting? There have been some events worth noting recently:

. . . New technology sessions were well attended at the 65th Castings Congress, despite the far-Western location and cancellation of the equipment and supplies exhibition. Interest in new technology was strong. (See our May issue, page 69.)
Attendance from east of the Rockies was better than expected.

. . . The attention given the Castings Congress by the consumer, business, and industrial press was strong. This is always an indication of the growing importance of an industry.

LONG WAY TO GO

Of course, a greater profit consciousness exists today in every industry. For metalcasting there's a long way to go. Even at the Congress, the traditional conservativeness of metalcasters was showing. This was reflected directly by on-the-spot interviews:

. . . Many metalcasters reveal a strong reluctance to move rapidly toward mechanization (although bellwether foundries are moving quickly in this direction). Note the story beginning on page 43, this issue.

. . . Many metalcasters are not geared to turn new technology into sales, to use it as a sales and marketing tool. This was evident at MODERN CASTINGS' First Invitational Seminar, also held at the Congress. See page 46, this issue.

Possibly the size of most metalcasting plants, or the gap created by great diversity in jobbing operations as compared to captive plant operations, page 43, is a reason for this conservatism.

But the fact remains that "sales muscle" is sorely needed by every metalcaster, if he is to survive. A division of opinion does exist on how to spark growth. See "Focus on the Future" on page 49.

COMPETITION SPURS DECISION

Competition from without and within the metalcasting industry may make the decision for the metalcaster.

. . . Just this month the use of plastics for automobiles was seen doubling in the next five years. Making this prediction was John Mickey, plastics engineer, Ford Motor Co. Speaking at the Plastics for the Automotive Industry Conference, he declared that the current average of plastics per auto will have increased from 22 pounds to 100 pounds by 1965.

. . . Intra-industry competition between light and heavy metals is stepping up, and metalcasting is head-over-heels in the battle. Marketing as well as technological changes are factors. In the fray on both sides are the big companies. They're armed with know-how, and research and promotional dollars.

If you are looking at the long range economic picture, you'll decide that now is the time to modernize your metalcasting business. It is forecast by one economist that the American economy will enter a period of quickened growth in the mid-60's, or even sooner. Then a plateau will be reached as increase in the nation's population levels out for a while.

CAST FOR THE RESEARCH NEEDS OF THE FOUNDRY INDUSTRY

The Magcobar Research and Development Center at Arlington Heights, Illinois, helps the Foundry Industry produce better castings at lower costs through research.

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Circle No. 187, Pages 127-128

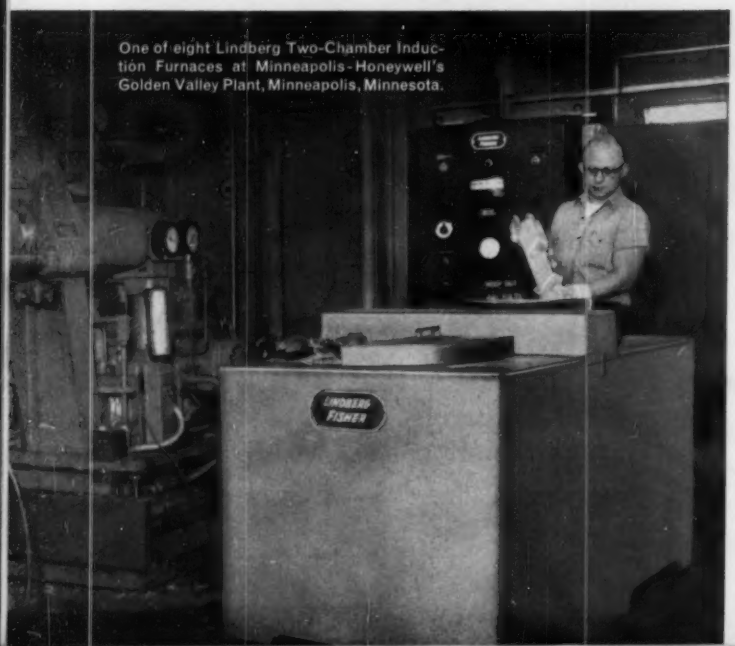
ART GEORGE has a good word to say for Lindberg Melting Furnace performance

QUOTE

Mr. Art George, Senior Production Engineer, Golden Valley Plant, Minneapolis-Honeywell Regulator Company, Minneapolis, Minn.

"Our installation of eight* Lindberg-Fisher Two-Chamber Induction Melting and Holding Furnaces has given remarkable service for more than four years. In this period, with the help of a well executed Honeywell maintenance program, the installation has been unusually trouble-free. Only one of the eight furnaces has required relining over this long period. Handling more than 1,000,000 pounds of aluminum and zinc annually, the installation has unfailingly provided the consistently high quality of metal our precision instruments require."

**Altogether, 44 Lindberg Furnaces are in operation in various Honeywell plants.*



One of eight Lindberg Two-Chamber Induction Furnaces at Minneapolis-Honeywell's Golden Valley Plant, Minneapolis, Minnesota.

These eight Lindberg-Fisher Induction Furnaces melt and hold aluminum and zinc for die casting gas valve housings and other component parts. They are located at the die casting machines where ingot and scrap can be melted and held at the desired casting temperature in one convenient unit. Magnetic fluxing and stirring insures uniform temperatures and consistently clean metal.

In any production process where aluminum needs heat there is Lindberg equipment to apply it most economically and efficiently. Furnaces for melting and holding, casting stations, re-melting or heat treating are available in all capacities, electric or fuel fired. Get in touch with your Lindberg Field Engineer (see your classified phone book) or write us direct. Lindberg-Fisher Division, Lindberg Engineering Company, 2440 West Hubbard St., Chicago 12, Illinois.

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Around the World with Modern Castings

CHINA

The Institute of Foundry Practice at the Northeast Institute of Technology has solved the problem of removing practically unlimited quantities of sulphur from iron. Especially attractive to ductile iron producers, the process takes the unique approach of electrolyzing the slag. With the slag as the anode and molten iron as cathode, d.c. power sets up a flow of Ca and Mg ions from the slag into the iron. Ca and Mg react with S in metal carrying it back into the slag. Here the compound decomposes releasing SO_2 gas. Chinese find that desulphurization by the electrolytic process is efficient and cheap to operate. Process removes more sulphur to lower valves than any other method! Ductile iron foundrymen should find this approach opening the door to use of high sulfur irons formerly impossible to work with.

BRITAIN

Powdered graphite injection through the tuyeres of cold-blast acid-lined cupolas is now being used to reduce cost of charge materials. Carbon content of iron increases so chill and shrinkage are reduced. Less pig iron is used and a higher ratio of metal to coke means less coke consumption. Because of ease of starting and stopping the injection, foundrymen can produce different grades of iron in quick succession without altering the charges. Graphite injection makes it possible to produce high carbon iron without resorting to expense of basic slags or hot blast equipment.

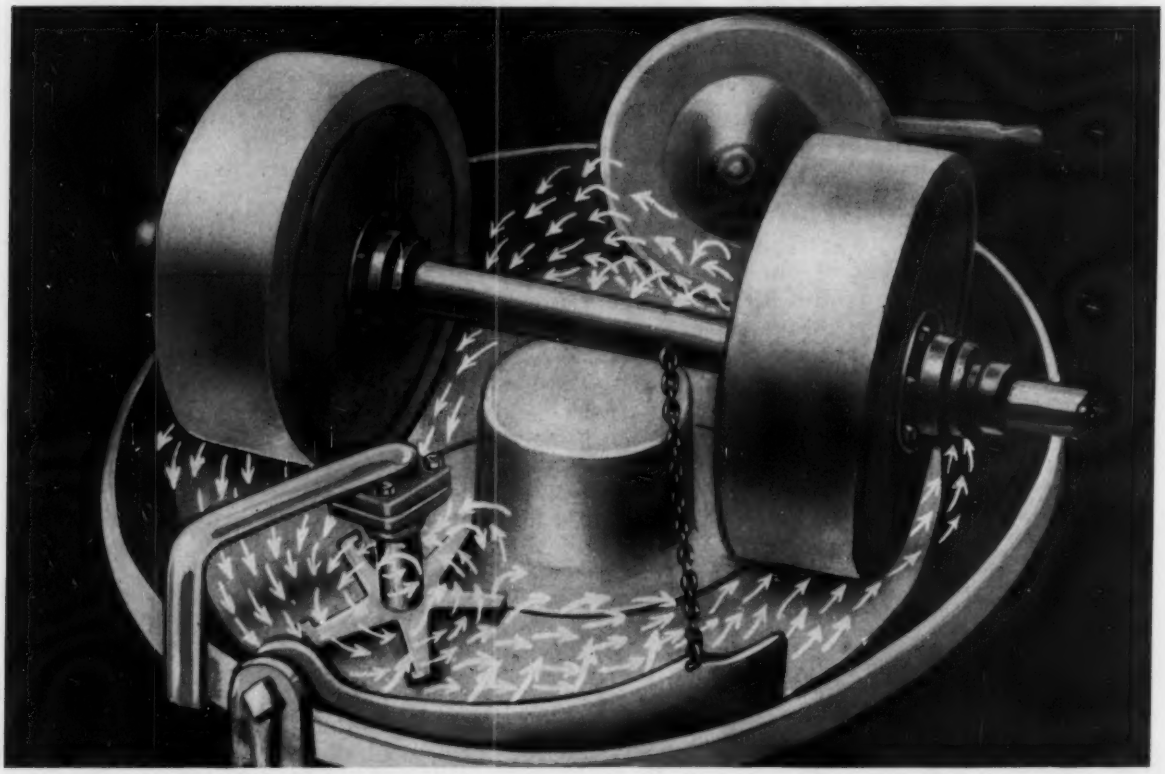
RUSSIA

World-wide attention is being focused on development of a gas-fired cupola which would eliminate the need for coke. An experimental model at the Kharkov Tractor Plant produces iron with a composition range of 2.35 – 3.35% C, 2.22 – 2.70% Si, 0.65 – 0.75% Mn and 0.03 – 0.04% S. A charge of pig iron, scrap, and ferrosilicon, requires 112 cubic meters of natural gas per hour for a melting rate of 12 metric tons per hour. The cupola has such special design features as two-way burners, refractory reflecting ring, and a spiral bottom sloping to the tap hole. Research on a gas fired cupola has been conducted recently at the University of Wisconsin and reported in MODERN CASTINGS, p 116, April, 1960.

INDIA

The National Metallurgical Laboratory focused attention on the latest research and industrial developments in the field of light metals by sponsoring a 4-day symposium. Technical know-how was exchanged by leading scientists and metallurgists from all over the world. Twenty-seven technical papers were presented. Some of the subjects discussed included: the U. S. beryllium and titanium industries, new uses for aluminum, a new wet-tensile strength test for molding sand used in aluminum casting, and magnesium developments.

You get thorough blending and tempering



with CLEARFIELD "Revolving Pan" MIXERS

All Clearfield Mixers work on the revolving pan principle, providing a balanced mixing and tempering action. As the pan rotates, centrifugal force keeps *all* of the batch in continual motion, adding to the mixing action of the mullers, agitator and revolving disc. There are no lags.

The mullers of Clearfield Mixers not only revolve on contact with the mixture, but also exert a sliding, twisting action which rubs or "smears" the bond on the sand grains, increases the speed and thoroughness of tempering. These mullers are wide faced and spread far apart to give maximum mulling area per revolution . . . high production is achieved without excessive pan speeds, reducing vibration, prolonging life of the machine.

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A double duty disc cuts all the material free from the revolving pan rim at each revolution, turns it over and diverts a continuous stream of material under the mullers. When moved to the discharge position it unloads the complete batch within 15 to 30 seconds! This discharge, in addition to being smooth, rapid and clean, has the important advantage of having an aerating effect because it shoots the sand out over the rim into the hopper in a finely diffused spray, depositing it in a soft fluffy condition ready for use.

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Circle No. 129, Pages 127-128

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10" x 12" through 24" x 24"

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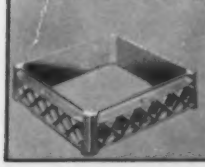
Used with HINES "POP-OFF" flasks, they'll provide economical, quantity production.



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REPORTING NEWS AND DEVELOPMENTS IN THE FOUNDRY USE OF BENTONITE

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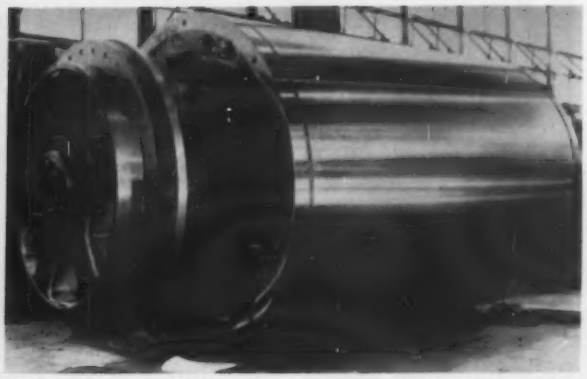


Compliments of Mr. Wm. Schneble, President
Advance Foundry Co., Dayton, Ohio

Rough casting weighing 32,420 lbs. and measuring 60" in diameter, 88" in length. It is a ductile iron casting selected as the best metal for the intricate design which gives excellent surface characteristics for machining, plus additional improved properties.

After machining. This finished ductile iron cylinder and subassembly has most unusual dimensional stability. Machined surfaces are of the highest order.

The above casting was made in dry sand using VOLCLAY western bentonite as part of the binder required.

VOLCLAY was selected because it furnishes the approved dry strength and hot strength properties required.

There must be no failure in hot properties. If this roll shows sand inclusions, or porosity after machining, a great loss occurs to the foundry.

Durability, which is the life of the bonding ingredient, must be of the highest order. It is assured with VOLCLAY.

Experienced foundrymen making this type casting **know that green properties are important** but it is the dry and hot properties of the molding sand that guarantees a satisfactory casting. **VOLCLAY serves these specifications.**

AMERICAN COLLOID COMPANY

SKOKIE, ILLINOIS • *Producers of Volclay and Panther Creek Bentonite*

Circle No. 130, Pages 127-128

At Wagner Castings Co....

25% savings in shipping labor with Wirebound Pallet Boxes

Bulk handling speeds weighing and shipping of castings

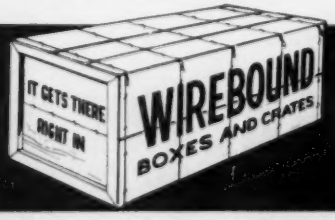
Savings of 25% to 30% have been realized by switching from bags and returnable wood pallet boxes to non-returnable Wirebounds at Wagner Castings Co., Decatur, Ill.

The time required to fill and tie bags, and the cost of returning wood pallet boxes have been eliminated. Even with their 1400-pound loads, these Wirebound pallet boxes stack safely three and four high on the shipping dock, conserving valuable space and speeding shipping operations.

Wagner's customers realize savings, too: handling is minimized—there are no bags to open, no boxes to return. Contents of the Wirebound pallet boxes are accessible for quick identification and for receiving inspection.

At Wagner, Wirebound pallet boxes loaded with malleable iron castings weigh in at about 1400 lbs.

You can realize similar savings by using Wirebound pallet boxes in your manufacturing, assembly and shipping operations. *Contact Wirebound box manufacturers for full information or write to the address below.*



WIREBOUND BOX
MANUFACTURERS ASSOCIATION INC.
222 W. Adams Street, Room 1495
Chicago 6, Illinois

1094

Circle No. 131, Pages 127-128

From and For the Reader . . .

HOW MANY CAUGHT IT?

I have read the May issue of MODERN CASTINGS and want to compliment you on its contents. I feel that the staff has done a fine job in getting out this Convention Issue, especially in the summary of the first report of the Metalcasting Trends Panel.

On page 7, I believe there is a mistake. On lines 12 and 13, you say "significantly, more than 56 per cent of panel companies will purchase obsolete equipment during the last six months of 1961."

You surely mean *replace* obsolete equipment, because I notice on page 46 you mention that 54 per cent of the bellwether companies reporting expect to replace obsolete equipment during the last half of 1961.

F. W. Shipley
Foundry Manager
Caterpillar Tractor Co.
Peoria, Ill.

I sure hope the other 46 per cent doesn't join your 54 per cent and purchase obsolete equipment (page 7, May issue), or I won't have a job. As I always say, "If you're going to boot one, might as well make it a dilly."

C. R. Heller

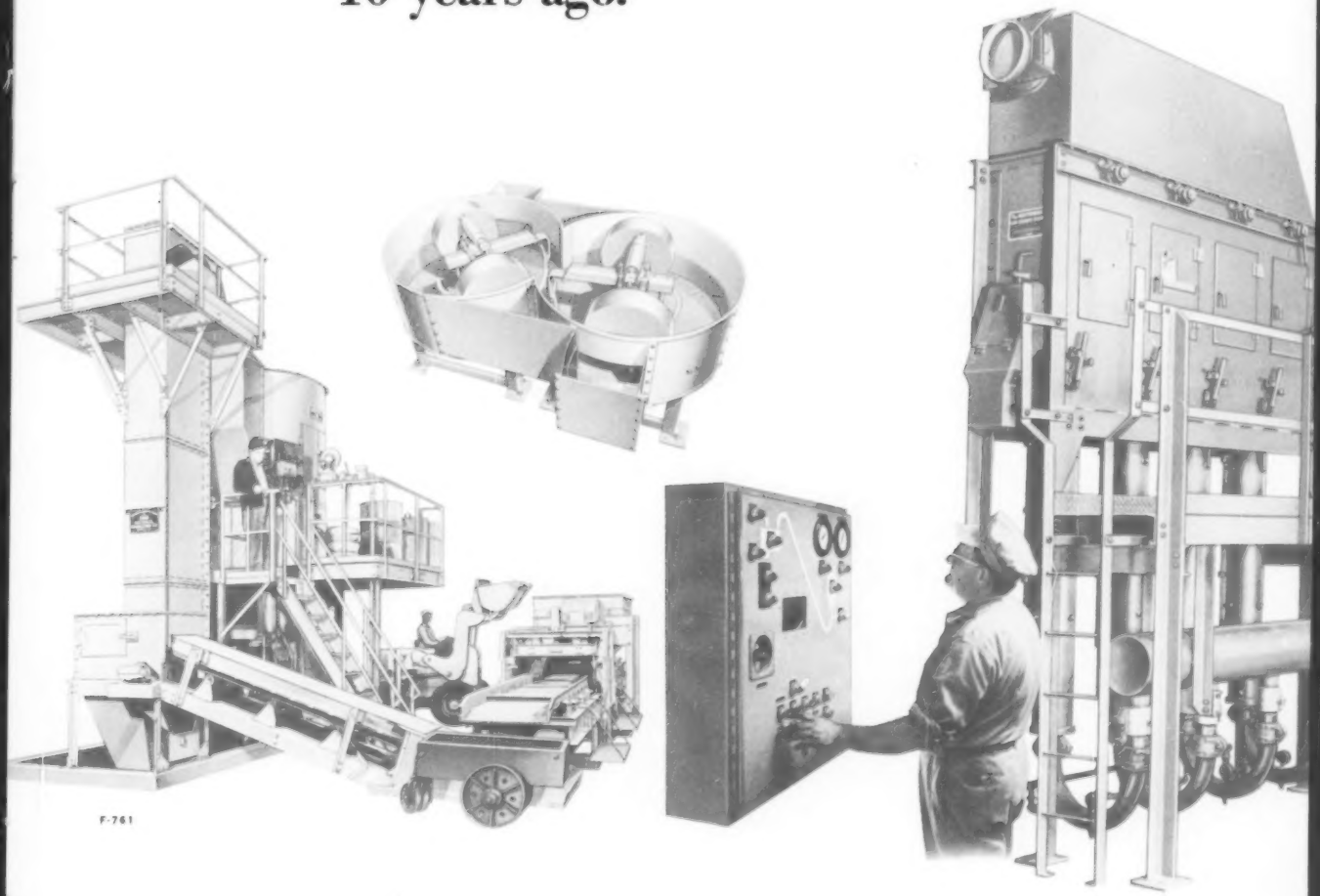
Editor's Note: Taking a cue from Mr. Heller, we admit to "booting a dilly" in the May Looking at Business column. Even in this space age, equipment doesn't become obsolete in six months. The error, itself, was one of communications—between the MC office and the printer, but its significance lies more in the fact that these two astute gentlemen, and many others, are both aware of and interested in this phase of metalcasting. You all deserve honorable mention.

SEEK MARKET DATA

A careful analysis of your very interesting article "40 Leading Markets for Metalcasters Today" left a question in our minds.

Under "Gray and Malleable Irons," figures for "Weight of Castings Purchased" and "Delivery Cost" are given

Foundrymen are winning the battle of profit vs. cost with National equipment that was only an idea 10 years ago.



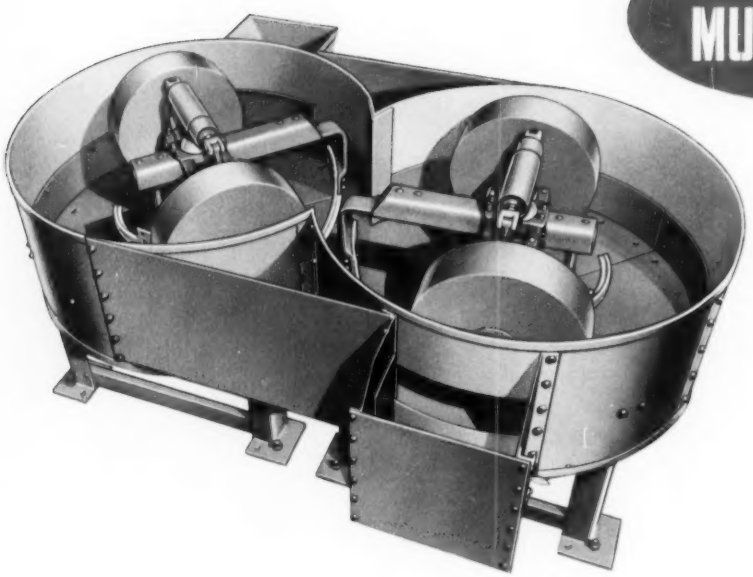
F-761

National prospers only as foundrymen prosper . . . through the acceptance of improved technology and the development and use of equipment designed to reduce the cost of processing and handling your most expensive commodity: SAND.

NATIONAL ENGINEERING COMPANY • Chicago 6, Illinois

I mull sand the new way...
Continuously:
I do it carefully and thoroughly
and, I'm big enough
or small enough...
to meet *any* molding requirement.

SIMPSON
MULTI-MULL



Foundrymen who are aggressively waging the battle of cost vs. quality are winning—with Simpson Multi-Mull.

Can you afford to overlook the competitive advantages of continuous and controlled mulling?

Conveyor: 1961

Pipe line routing serves to conserve the foundryman's most valuable asset: manpower and real estate, . . . by reducing the cost of handling his most expensive commodity:

Sand

Can you afford to overlook the competitive advantages of reducing your sand handling costs?

Foundrymen who are aggressively waging the battle of cost vs. profit are winning—with National Air Conveyor Systems. Write for literature.

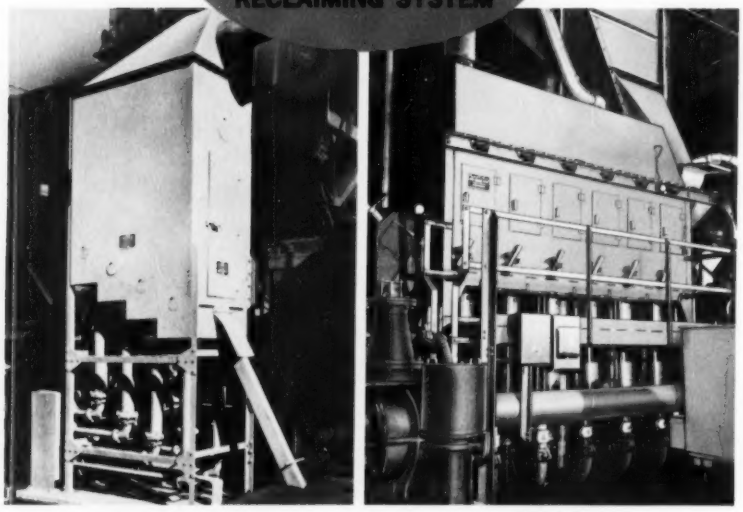
In 10 years, National has brought sand reclamation of age.

Every day thousands of dollars are being saved in our foundry industry.

...because 70 National units are in use.

Your 1961 National system will come complete with classifier, rotary screen and individual cell controls.

NATIONAL
EVEN-FLO
RECLAIMING SYSTEM



1951:
A Sand Scrubber unit

TODAY:
An integrated Sand Reclaiming System.

Foundrymen who are aggressively waging the battle of profit vs. cost are winning with the National System.

There is a unit near you . . . Ask your National agent to show it to you . . . Write for literature.

NATIONAL ENGINEERING COMPANY

Machinery Hall Building • Chicago 6, Illinois

for the Farm Machinery and Equipment Industry. These figures are totals for a very large group. To us, the breakdown of this group to three of its components has great interest. These components are gray iron, malleable iron and nodular iron.

If the figures for the above casting activities were apparent or segregated, we would appreciate your sending them to us.

P. J. Collins
Product Price Estimator
Design Cost Analysis Dept.
Tractor & Implement Div.
Ford Motor Div.

Editor's Note: We regret to say that the figures, based on the 1958 Census of Manufactures produced by the U.S. Department of Commerce, were not broken down beyond what is revealed in the article. In all cases, gray iron and malleable castings were lumped together as a single figure.

EXCHANGE PAPER WINS PRAISE

We have read the article "Melting Practice for Aluminum Die and Permanent Mold Castings" by D. L. Colwell, April 1961 issue. As this article contains some pertinent information which we desire to impart to other members of our organization and also to maintain a file, we would like to obtain additional copies.

J. G. Gantner
Head, Metallurgical Research Dept.
The National Cash Register Co.
Dayton, Ohio

REQUEST FROM TAGLIAFERRI

We would be very grateful if you could send us the March 1961 issue of MODERN CASTINGS where an article entitled "New Process for Foundry Iron" (AFS TRANSACTIONS) is written. This article interests us very much.

Forni Elettrici A. Tagliaferri
Milan, Italy

A SAFETY WARNING

The matter of advertising in the trade magazines indicating a disregard for proper safety practices was a subject of discussion at a recent board meeting.

It was generally agreed that for

LET THE MAN FROM AMERICAN HANDLE YOUR REFRACTORIES AND CRUCIBLE NEEDS

He is specially trained and has the engineering background to use a whole family of American Refractories and Crucible products to help solve your molten metals handling problems. Let him prove to you how American products will . . . IMPROVE YOUR PRODUCTION — LOWER COSTS — LAST LONGER.

★ **STARRBIDE CRUCIBLES** . . . with carbon bonded "thin wall" construction gives you *more metal per heat; more heats per furnace; and use less fuel per pound of metal.*

★ **STARR BASEBLOCKS** . . . to fit any crucible and furnace are readily available from American.

★ **STARRLUM SUPER-REFRACTORY CEMENTS** . . . meet all refractory requirements under all plant conditions!

★ **STARR RAMMING & PATCHING MIXES** . . . Nine mullite or alumina-based mixes provide an answer to every need.

★ **SPECIAL POURING TROUGHS, SKIMMERS, SHAPES, ETC** . . . are another part of American's regular service to you.

★ **STARRBIDE SLAG HOLE BLOCKS** . . . reduce shut downs because they last longer!

★ **BONNETT STOPPER HEADS** . . . feature patented assembly details to improve your operations and reduce costs.

ENGINEERING LABORATORY SERVICES

Technical assistance in the use and installation of crucibles and all kinds of refractory materials is a new, improved service available through The Man From American. In the field and in our laboratory, engineers and production experts are prepared to work with you in every way to help improve your metals melting and pouring operations.

GOT A PROBLEM? TELL IT TO THE MAN FROM . . .

AMERICAN REFRACTORIES & CRUCIBLE CORPORATION

North Haven • Connecticut

Circle No. 157, Pages 127-128

No Better Iron At Any Price

WOODWARD

Foundry • Malleable • Bessemer

Woodward produces irons in a variety of analyses in order to meet the specifications of "out-of-the-ordinary" castings. No matter what your special requirements may be, Woodward can meet them.

Woodward Iron is your assurance of complete satisfaction, both for you, the Foundryman, and your customer.

SPECIAL NOTE

You will appreciate the quick and efficient service Hickman, Williams will give you. Call any "H.W." office —

Over 71 Years of Service to American Foundrymen

Hickman, Williams & Company

CHICAGO • DETROIT • CINCINNATI • ST. LOUIS • NEW YORK
CLEVELAND • PHILADELPHIA • PITTSBURGH • INDIANAPOLIS • ATLANTA
Established 1890

Circle No. 133, Pages 127-128

quite some time there have been a number of advertisements and articles with pictures showing foundry operations with men not wearing safety goggles or safety equipment. This obvious oversight defeats the activities and efforts of our Safety Committees toward effective safety in foundries.

It seems to us that in reviewing these pictures, it would be a very simple matter to make corrections which would promote safety rather than encourage a disregard for it.

Harry Blumenthal
Chairman
Twin City Chapter
AFS

Editor's Note: This is a well-deserved criticism that will be heeded. It is practice to keep control over such picture presentation, but at times a professional photographer's zeal for a better "shot" will result in a safety slip because the individual is not actually working at the time. Our staff will make every effort to convince photographers that the safe way is the only way.

DEZINCIFICATION PROBLEM

Our company uses a large number of brass and bronze castings in the products we manufacture. Because these products are subjected to all types of atmospheric conditions, we are concerned with the problem of dezincification. In order to control this problem we have limited the zinc content of the brass we use to 15 per cent maximum. This restriction has troubled our engineers since some of the higher zinc brasses have advantageous properties.

For this reason, we are investigating the possible use of inhibitors in the metal, such as arsenic, antimony, etc. If you have information on this subject or references to pertinent literature, we would appreciate hearing from you.

J. S. M.

Editor's Note: Even though arsenic, tellurium, phosphorus and antimony have been utilized in wrought brass and bronze alloys to lowe dezincification, the addition of these elements can be detrimental to the mechanical properties of similar alloys when cast. There are two alloy bronzes which you might consider. The first is a nickel aluminum bronze containing approximately 4-1/2 per cent nickel, 10-1/2 per cent aluminum, 4-1/2 per cent iron and the balance copper. Another alloy, developed in England,

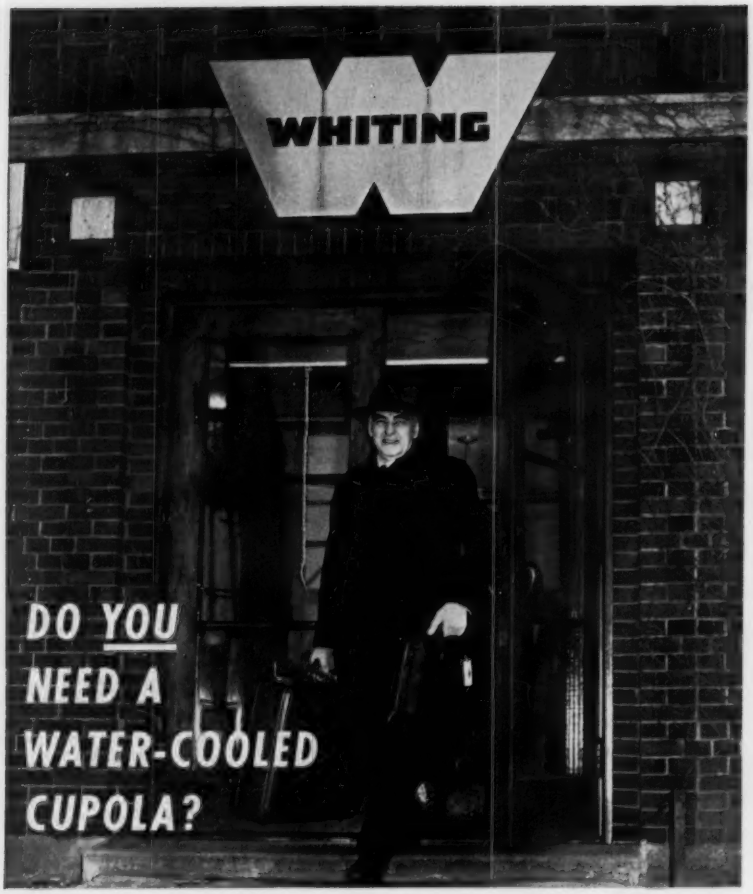
WEDRON

SILICA SANDS

99.9% PURE SILICA
WEDRON
SILICA COMPANY
INDUSTRIAL SAND

WEDRON SILICA COMPANY • 135 So. La Salle Street, Chicago 3
MINES AND MILLS IN WEDRON, ILLINOIS

Circle No. 137, Pages 127-128



LET THIS MAN HELP YOU DECIDE!

Walter R. Jaeschke (Jas'ke) is a Whiting consulting metallurgical engineer and an international consultant on foundry cupola problems. His recommendations have slashed melting costs in Europe, South America, South Africa and Japan, as well as for scores of U.S. firms. An authority on water-cooled cupolas, he consulted extensively on the world's largest—built by Whiting for Acme Steel.

If you are seriously debating the merits of liningless, water-cooled cupolas, why not draw on the wealth of this man's experience? He knows intimately the conditions required to make water-cooled cupolas profitable. He also recognizes those circumstances which make them impractical or uneconomical.

Walter Jaeschke is available—without charge or obligation—to survey *your* needs at your convenience. Whatever his recommendations, they will be based on the dollars-and-cents requirements of your particular operation.

FREE: Bulletin FY-176, *Water-Cooled Cupolas.* Write Whiting Corporation, 15628 Lathrop Avenue, Harvey, Illinois. In Canada: Whiting Corporation (Canada) Ltd., 350 Alexander Street, Welland, Ontario, Canada.

90 OF AMERICA'S "FIRST HUNDRED" CORPORATIONS ARE WHITING CUSTOMERS

WHITING

MANUFACTURERS OF CRANES; TRAMBEAM® HANDLING SYSTEMS; PRESSUREGRIP; TRACKMOBILES;® FOUNDRY, RAILROAD, AND SWENSON CHEMICAL EQUIPMENT

FOUNDRY EQUIPMENT

Circle No. 135, Pages 127-128

has approximately the following composition: manganese 12 to 13 per cent, nickel 2 per cent, aluminum 7 to 8 per cent, and iron 2 to 3 per cent. We also know that some of the manganese bronzes are improved in terms of tendency for dezincification by the addition of tin, but the effect is not 100 per cent satisfactory.

A DIFFERENT OPINION

In a recent issue of your magazine you make the statement that used foundry and core sand could be used to back fill around cast iron water mains. I am inclined to differ with you on this matter.

If foundry and core sand were completely free of all extraneous materials, it could give satisfactory service. On the other hand, experience indicates that things other than sand very often become mixed in with the waste material.

Some of these things, such as bits of carbon, slag, coke, and iron could very easily cause corrosion. It is our practice to recommend against the use of this material.

Thomas F. Wolfe
Cast Iron Pipe
Research Association
Chicago, Ill.

Editor's Note: Does anyone else have an opinion on this subject?

RAPID ALUMINUM TEST

One of the smaller foundries in Canada posed a question which our research laboratories were unable to answer. It is as follows:

"Does a method exist for a rapid chemical (non-spectrographic) determination of aluminum in aluminum and magnesium bronze? We define a rapid determination as one which can be used, for instance, while a melt is waiting to be poured."

We would greatly appreciate any information you may have concerning this problem.

Technical Information Service
National Research Council
Ottawa, Ontario, Canada

Editor's Note: As far as we know, there is no rapid method for the determination of aluminum with the exception of the spectrographic methods, although a coloimetric method is sometimes used and is much faster than conventional procedures. Perhaps someone is working on this problem and has made progress. We invite comments.

FOUNDRY PROVEN
Dietert-Detroit Moldability Controller attached to sand mill
CONTROL MOLD QUALITY automatically
WITH THE NEW
DIETERT DETROIT MOLDABILITY CONTROLLER

MOST IMPORTANT SAND CONTROL DEVELOPMENT IN YEARS

SIMPLICITY . . . 1. No parts in sand mixer. **2.** No complicated electronic circuits. **3.** No maintenance problems. **4.** No moisture juggling. **5.** No electronic technology needed to understand why unit works.

OPERATION . . . 1. Sand sample is taken from small opening in side of mill. **2.** Water is added from two valves while sand falls through a screen. **3.** Water is cut-off when sand is able to pass over screen. **4.** Discharged sand is of a selected and controlled moldability to give constant ramming qualities. **5.** The Dietert-Detroit Moldability Controller will adjust moisture to produce the proper molding sand while composition is changing under normal plant practice.

SAND CONTROL . . . 1. Sand composition is predicated upon quality of a master or production mold. **2.** Any shift in moisture level means the system sand is changing. **3.** Use laboratory sand tests to determine what change is taking place. Check strength, permeability, fineness and ingredient additions. **4.** Use master mold pattern to measure mold quality with 6 new mold quality tools.

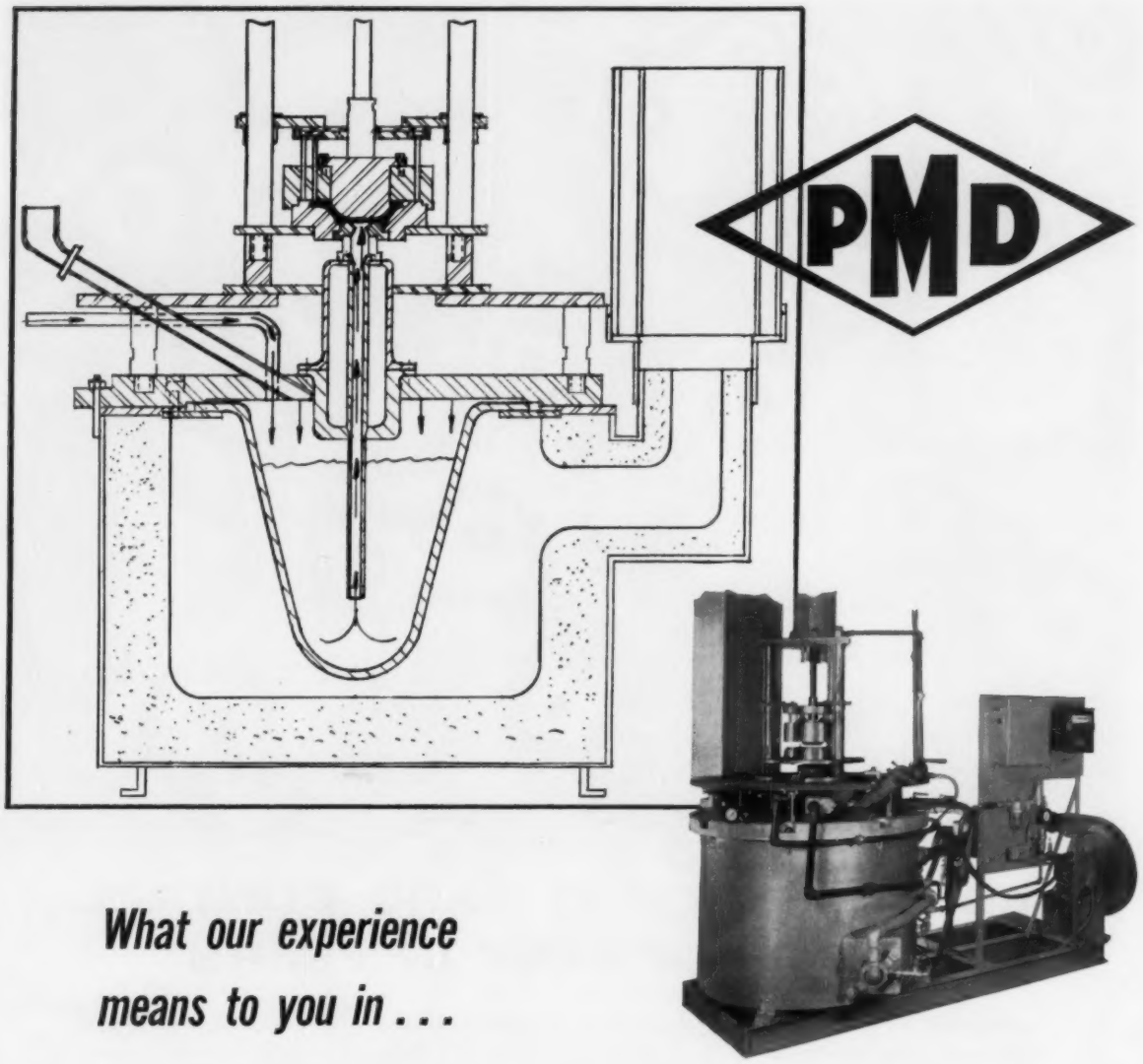
RESULT . . . 1. A greatly improved sand control. **2.** A direct approach. **3.** A positive end-property control obtained with moldability and mold quality control. **4.** A more satisfied group of molders and a sand system that requires much less supervision. **5.** A more profitable operation.

YOU ARE INVITED TO COME TO DETROIT TO SEE THIS DEVELOPMENT

DIETERT DETROIT

HARRY W. DIETERT CO.
9330 Roselawn • Detroit 4, Mich. • *Tel.* WE 3-9790
Send me complete details on your Moldability Controller.
NAME_____
TITLE_____
COMPANY_____
ADDRESS_____
CITY_____ STATE_____

Circle No. 127, Pages 127-128



PMD

What our experience means to you in . . .

LOW PRESSURE CASTINGS

Low pressure casting is occupying an important place in the metallurgical industries as a major development in the technique of permanent mold casting. The success of this type of casting is due, in part, to the technical knowledge and manufacturing skill of the personnel at Permanent Mold Die Company. Their experience makes it possible for PMD to offer you the finest quality low pressure casting machines available. These machines assure close tolerances and reduced trimming operations.

The PMD low pressure casting process deviates from the standard method only in the introduction of the metal to the mold. The mold is placed above a pressurized, airtight furnace; the molten metal is then forced through a tube into the mold from below. Pressure is held just long enough for the metal in the mold cavity to solidify, then it is released, allowing the excess metal to flow back into the molten bath.

It is obvious that the gating system can be simplified and the risers can be reduced to a minimum. These PMD machines greatly increase the ratio of net casting to the amount of metal poured. This results in a substantial reduction in production costs.

Write today for more detailed information about PMD automated molding machines and the savings they can mean to you.

FINISHED PRODUCT OF ABOVE DIAGRAM

This ashtray is an aluminum casting made from the PMD low pressure casting machine shown above.

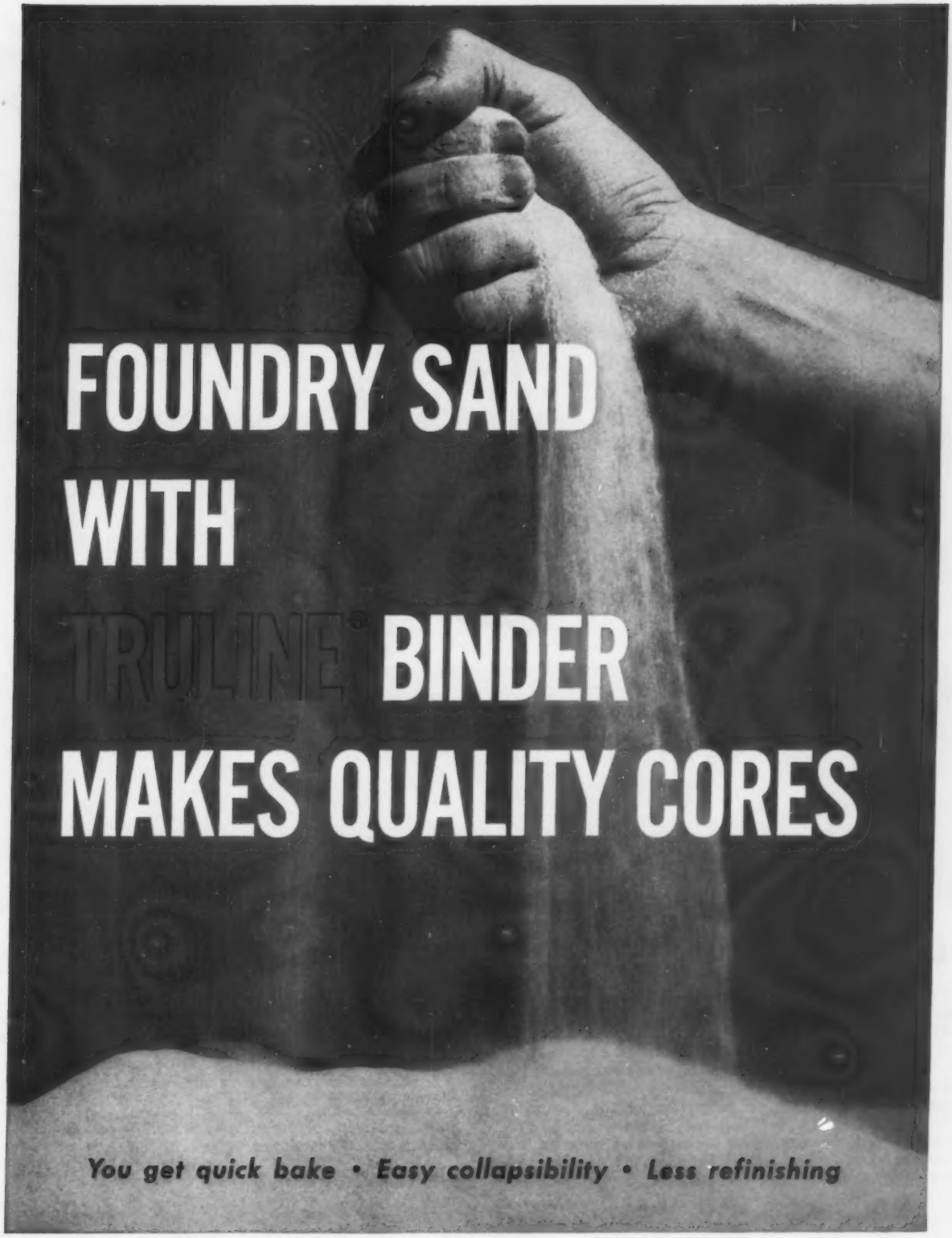
PMD

PERMANENT MACHINE DIVISION

A Subsidiary of Permanent Mold Die Co.

2275 E. 9 MILE RD. • WARREN, MICHIGAN

Circle No. 132, Pages 127-128

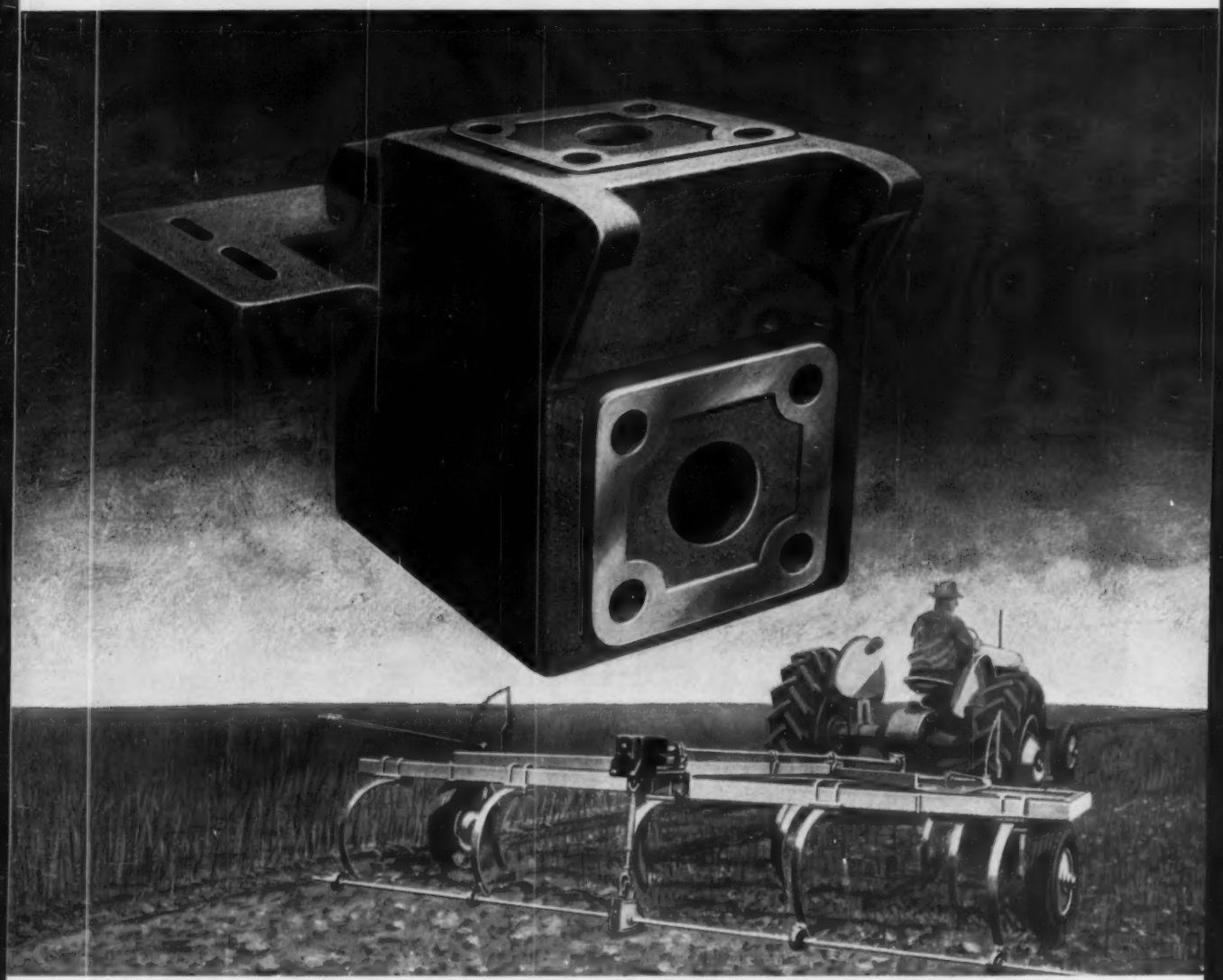


Naval Stores Department
HERCULES POWDER COMPANY
INCORPORATED
Hercules Tower, 910 Market Street, Wilmington 99, Delaware

NF61-1

Circle No. 138, Pages 127-128

How the Foundry Industry Serves America . . . #15 of a Series



CAST IRON MITER GEAR BOX REPLACES WELDMENT, LOWERS UNIT COST 54.9%

Working off the tractor power take-off, this cast iron miter gear box operates a rod weeder that pulls out weeds as the field is plowed. Formerly a weldment, the gear box then required seven machining and fabricating operations, cost $25.32 to make. Now, as a gray iron casting, it's produced for just $11.40! Included in the cost is the cast iron cover which doubles as an identification nameplate for the equipment.

Besides lowering unit cost 54.9 per cent, the conversion from a weldment to a gray iron casting brought about improved product appearance, and increased production with less manufacturing equipment. The excellent dampening characteristics and resistance to distortion of the iron casting preserve close tolerance of oil seals and reduce lubricant leakage.

This is one more example of how versatile, modern iron castings can reduce manufacturing costs and solve many of the complicated problems of industrial design.

For the production of structurally sound iron castings, Hanna Furnace provides foundries with all regular grades of pig iron . . . foundry, malleable, Bessemer, intermediate low phosphorus and Hanna Silvery.

Facts from files of Gray Iron Founders' Society, Inc.

HANNA
THE WELL KNOWN NAME IN IRON

THE HANNA FURNACE CORPORATION

Boston • Buffalo • Chicago • Detroit
New York • Philadelphia

Hanna Furnace is a division of **NATIONAL STEEL CORPORATION**

Circle No. 139, Pages 127-128

In the interest of the American foundry industry, this series of ads also appears in

STEEL

IRON AGE

FOUNDRY

AMERICAN METAL MARKET

How the Foundry Industry Serves America . . . #15 of a Series
CAST IRON WORM GEAR BOX REPLACES WELDMENT, LOWERS UNIT COST 34.9%
YOUR NAME HERE

FREE!

REPRINTS OF THIS AD WITH YOUR FIRM'S SIGNATURE

If you would like to have reprints of this ad to mail to your customers and prospects, let us know. Reprints will have no Hanna product message or signature, but will be imprinted with your firm name and address. Absolutely no obligation. To order your reprints, fill in and mail the coupon below.

The Hanna Furnace Corporation
Detroit 29, Michigan

Please send me_____reprints of Ad No. (No.)

_____of your Foundry Industry Series.

Imprint as follows:

_____

_____

_____

Send reprints to:

NAME_____

I understand there is no charge for this service.

Human Nature—Biggest Block in Selling Safety

by HERBERT J. WEBER

Years ago I was asked to give my conception of my job in industrial hygiene. I stated that it was largely one of trying to sell an almost unsalable commodity; that a knowledge of industrial-disease exposures and their prevention was secondary.

I could say that truthfully because few people in industry cared and most couldn't be bothered.

One top management man even thought that industrial hygiene was an advanced form of latrine inspection made necessary by the installation of modern plumbing in factories.

I have seen changes in attitude come about slowly, perhaps not so much from the salesmanship of industrial hygienists and safety men, but rather from the slow attrition of changing times.

I recall having difficulty selling a vice president on the need for ventilation to prevent lead poisoning.

When I'd enter his office and start my sales pitch, he'd assume the frigid hauteur of a lame parrot making a sneak on a rotten peanut. He'd then begin reading and signing the day's mail in order to get through to me, without directly saying so, that I ought to get lost.

One day I told him that the laboratory report showed his blood-lead level had gone beyond normal. With great relish, I described in vivid detail the pain and sickness a man suffers when the lead in his body finally brings on acute poisoning.

Signing the mail could easily wait until the next day then, because now he was personally involved. I don't know if the motivation was due to salesmanship or to moral duress—but it worked. Brother, you couldn't get him to go into the plant again until the ventilation was in! That made a difference. He was scared now.

This leads me to another thought. We're all innately selfish. The most interesting subject in the world is ourselves. When someone tells you, "it isn't the dollar, it's the principle of the thing", it's probably the dollar every time, especially if it's his dollar.

A man can't act without a motive. He has to see a profit or benefit to himself in order to do anything and he will inevitably choose the lesser of two evils when he is confronted with two distasteful horns of a dilemma.

Man works because "self" would suffer if he didn't. He's a bum because he loves *his* indolence. Remember the song about Lazy Bones? "And when you go fishin' I bet you keep wishin' the fish don't bite on you line". No matter what man does, he always does it because he gets something out of it either immediately or eventually. He loves praise and resents blame. He craves attention and hates being unnoticed.

I know that these fundamentals of human nature can be exploited to cure the accident prone; to install successfully a 100 per cent eye protection program; to improve the safety record; to use properly and to keep in good condition ventilation equipment and the like.

As proof, I quote from a paper given by Carter De Laittre, Vice President of Minneapolis Steel Castings Co., at the 1960 National Safety Congress.

"To recognize and give credit for safe performance where credit is due is extremely important to our safety program. At Minneapolis Electric Steel . . . . we feature stories concerning employees who display their interest in safety. We waste no time in installing employees in clubs such as the Wise Owl Club and Turtle Club if they are qualified. We have found that articles in the local paper featuring the safety efforts of our employees stimulate added interest in our safety programs."

The fine safety record at that plant is well known.

Vancoram briquettes

make mistakes hard to make! Mistakes cost money–but distinctively shaped Vancoram Briquettes cut errors to the bone. They help assure that the right amount of the right alloy gets into every melt. VCA supplies every major type: FERROSILICON (Cylindrical), FERROMANGANESE (oblong), FERROCHROMIUM (hexagonal), and SILICOMANGANESE (square). Every one sets a standard of excellence! Get Vancoram Briquettes in bulk, bags, or pallet boxes. Call your VCA representative for facts and figures—or any of the VCA Distributors listed below. Vanadium Corporation of America, 420 Lexington Avenue, New York 17, N.Y. Chicago • Cleveland • Detroit • Pittsburgh

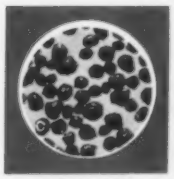
VCA Products are distributed by: PACIFIC METALS COMPANY, LTD.; STEEL SALES CORPORATION; J. M. TULL METAL AND SUPPLY COMPANY, INC.; WHITEHEAD METALS, INC.; WILLIAMS AND COMPANY, INC.

VANADIUM
CORPORATION OF AMERICA
Producers of alloys, metals and chemicals

Circle No. 140, Pages 127-128

TERMCO EXPANDS 1/8 AS MUCH AS SILICA SAND

TERMCO—the new, hard, round-grain carbon sand—is solid, inert carbon. Its thermal stability is far superior to the best silica sand. And it needs no iron oxide and cellulosic cushioning agents. With TERMCO, there's no veining, scabbing, penetration or burn-on. Castings just naturally come cleaner, more accurate, precise. That's why TERMCO cores and molds are the most dependable — especially for the most difficult casting jobs. And TERMCO replaces zircon, olivine, and other non-silica sands at lower net cost. Requires no special methods or equipment. Why not get all the facts on TERMCO—now! Send today for detailed information.



UNRETOUCHED MICROPHOTO

New Molding Medium for Highest Quality Castings

TERMCO

HUMBLE OIL & REFINING COMPANY • DETROIT 18, MICHIGAN • U. S. PATENT NOS. 2830342, 2830913.

Circle No. 141, Pages 127-128

Judging Apprentice Contest Is a Big Job

By R. E. Betterley

It's never an easy task to judge a highly competitive national contest. It's doubly difficult in the case of the annual Robert E. Kennedy Memorial Apprentice Contest when the honors and awards attract a large number of excellent entries.

After working with these contests for four years, I find it hard not to sing praises for the foundrymen who so unselfishly contribute their time and talents to this far-reaching educational program. I am speaking now primarily of the people who serve as judges. However, this praise also holds true for all contest committee men and the industrial companies who provide help and materials. Without this service the program would be next to impossible. This year, for example, the Garvey Patten and Mfg. Co., South Bend, Indiana provided the finished drawings and master patterns and the U. S. Gypsum Co., Chicago, furnished the plastic molding patterns.

For justifiable reasons, the names of the judges in the National Competition are not publicized. With this lack of public recognition, these men are providing a dedicated service to this program and *we hope* they will accept this as an open expression of our sincere appreciation.

For a better picture of the magnitude and details of this responsibility, let's step behind the scenes for a moment. The date is April 7, 1961, University of Illinois, Navy Pier, Chicago, Illinois. For weeks Prof. R. W. Schroeder has been supervising the receiving, uncrating and arranging of castings and patterns from all over the United States and Canada—129 total entries this year. Contest chairman, George Garvey, and the writer arrive early to prepare checking templates and arrange judging forms. Sixteen judges arrive at 9:00 am and, after being divided into Division areas and given brief instructions, the judging is underway. Experienced at this assignment, they carry on with a minimum of delay.

The traditional coffee-break period gave the judges a breather during the morning period. The group luncheon at noon was relaxing and provided the usual opportunity for the writer and others affiliated with the contest to express appreciation to the judges and discuss any details required to complete the judging in the afternoon. Dean Parker of the Engineering School was a guest at this luncheon.

It was understandable that the judges of wood patternmaking were *anxious* to resume their work. With 52 entries to check in this Division, they were really pressed for time. Incidentally, their job was not completed until 6:00 pm. This area is always difficult because of the number of entries and the *numerous* ways of making the pattern. An interesting and humorous situation also developed for this group. A pattern highly rated by two judges was finally challenged by the third judge as having back draft in the core box. To settle all arguments, the box was rammed and drawn. *Sure enough*—the box could not be drawn without breaking the core.

Here's the payoff! This entry, when checked with records (identity of all entries for judging purposes is by number only), was submitted by an apprentice who took *first place* in a previous national contest. On top of that, the entry was from the sharp-eyed judge's own company. Recent reports indicate the local chapter sending in this entry has some red-faced judges—we're pleased our national judge is not one of them.

The Gray Iron Division also had their problems when it was noticed several high-ranking entries had not adhered to the rules on gating and risering. Penalties for these discrepancies were difficult to evaluate.

The Steel, Non-Ferrous, and Metal Pattern Divisions proceeded without difficulty because of fewer entries and less variation in the metal pattern parting. The judging is a big responsibility and a gigantic task. The judges donating this educational service are to be commended. I would hate to pay their combined salaries for this day's work.

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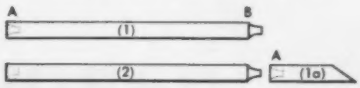

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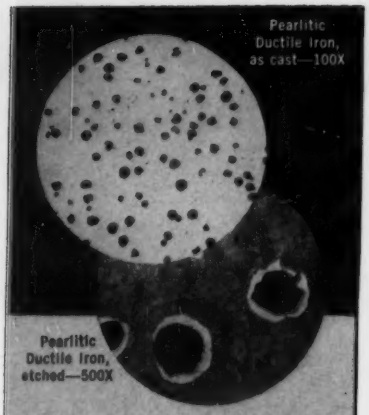

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Circle No. 145, Pages 127-128

DIETRICH'S CORNER

Free Advice That Won't Be Accepted

by H. F. Dietrich

Ever since my first foreman advised me that hard work never killed anyone—and then assigned me to the shakeout pit—I have been suspicious of anyone who seemed eager to give me free advice concerning my health.

Admittedly, almost everyone at one time or another becomes a reformer. Having had all the fun of making mistakes—and learning from the exciting experiences—the reformer feels it's his duty to prevent others from making those same mistakes and having the same fun. There is something in the chemistry of living that causes the "eager-beaver" radical of today to become the staunch conservative of tomorrow.

Having twice tiptoed gingerly around that little hole on the hill, I feel that I am in a position to become a reformer. Perhaps hard work isn't killing my friends, but something is. There are three points I'd like to make—aimed at them and you.

First, to that friend of mine who thinks he must personally visit the foundry at night to check the day's run of castings, I would like to say that those same castings will be there in the morning. You can't work day and night, and survive.

To prove this point we have only to observe nature. From the time man invented the night-light and eliminated the deterrent factor of outside plumbing, he has been trying to get along without the rest necessary to rebuild his body. With eyes unable to see well after dark, ancient man was forced to rest after sundown. With the prospect of a cold trip through the snow to outside plumbing facilities, it is surprising how a man can find excuses to extend his sleeping time into the morning. Without modern inventions, man is forced by nature to get the rest he needs. It is only in an artificial environment that he can burn the candle at both ends.

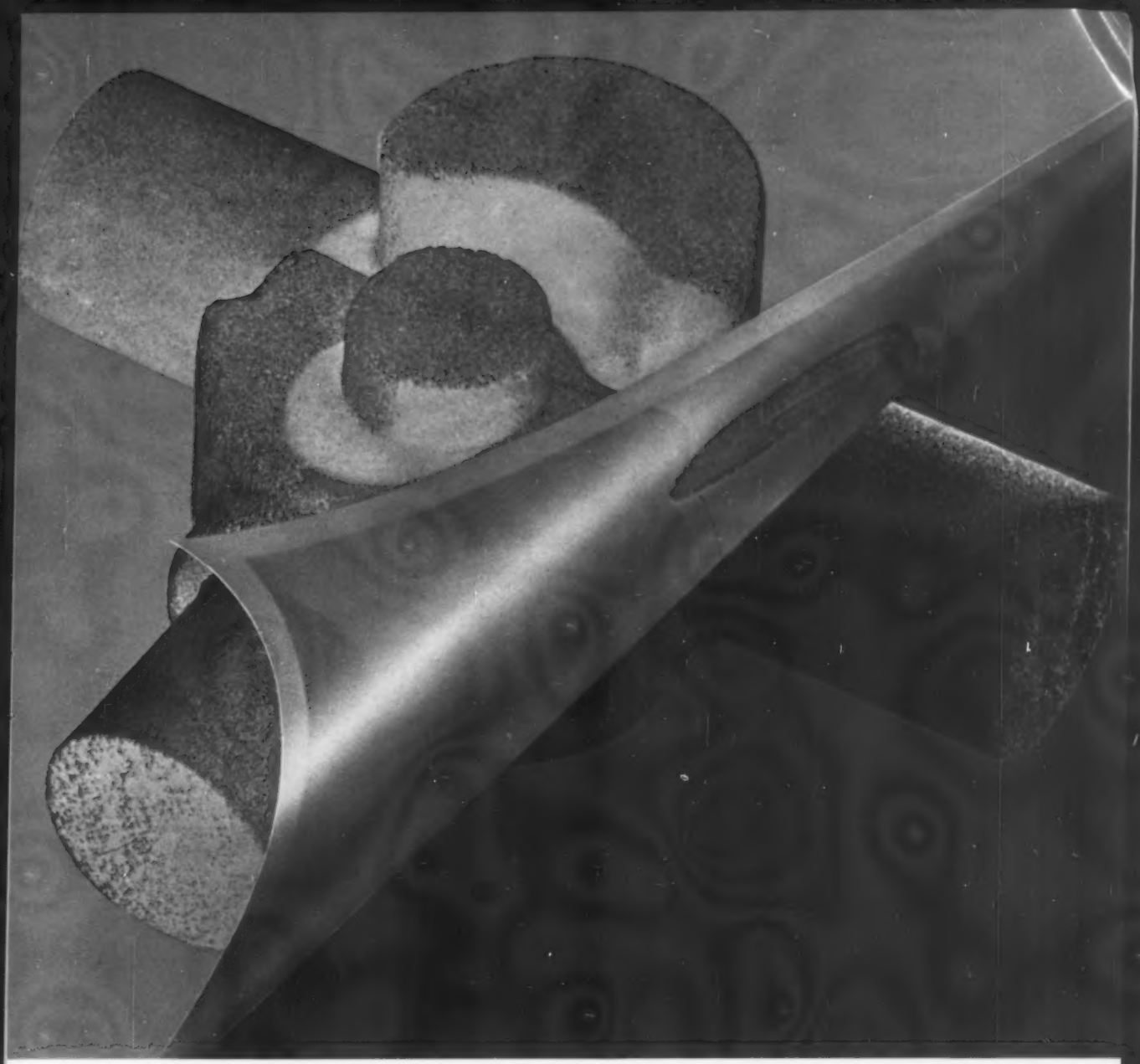
My second point is addressed to the oldtimer who was brought up on the propaganda that there should be no world outside of his work in the foundry. This is in error! If a man waits until he retires to pick up an interest other than his work, it is too late. The worker of today has an advantage over the oldtimer. He has the time and means to develop some outside interest before his birth certificate tells his boss that it is time for him to be retired. Soon after receiving his retirement banquet and gold watch—a silly gift because from there on, time means nothing to him—the oldtimer is taken away to Shady Rest. He's retired permanently. To live, a man must have a reason.

My third point is for Americans in general, and our car-load-lot foundrymen in particular. We do everything to excess. Thinking BIG is fine as long as we don't get carried away by it. But, we rush here and there like ants in a hive. We overproduce, drive cars too fast, eat too much, and rush through life blindly without stopping to admire the scenery. Everything must be done on an elaborate scale.

Statistics tell us that we have extended the life span of man. However, if we examine these statistics carefully, we find that we have merely extended the unproductive extremes of infancy and senility. We are losing our productive population at an alarming rate. We are living ourselves to death.

As a reformer, I suppose I should have a philosophy of life. This I should pass on with the hope that from my profound advice, someone will live a better life.

But, I know that one man can't turn the world, and my friends will do as they please anyway. This foundry business has been running for more than 6,000 years. It will still be running after this generation has written its page in history. So, to the Indispensable Man, the Oldtimer, and The Car-Load-Lot Eager-Beaver, I say, have fun. Make the same mistakes I did. There is nothing you can do that will permanently affect the industry one way, or another.



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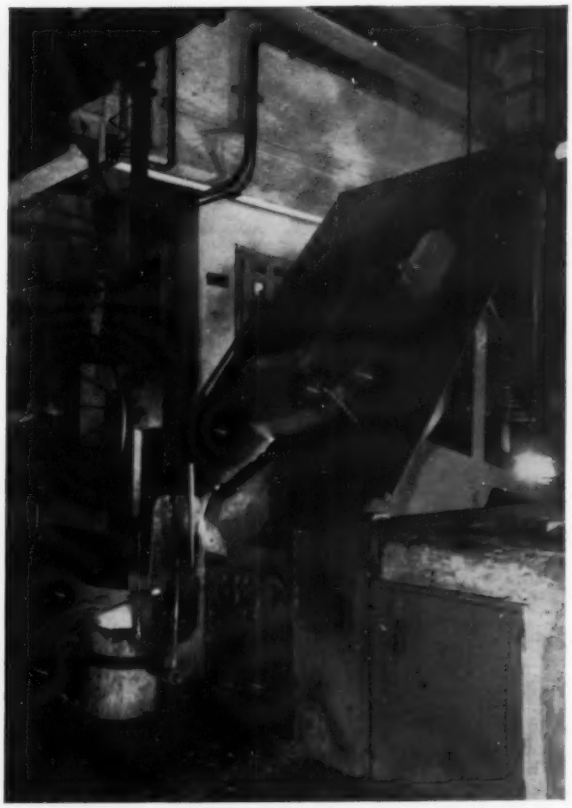

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Circle No. 148, Pages 127-128

METALGRAMS

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JUNE 1961

NEW ECONOMIES IN MAKING STAINLESS -- New oxygen-blown refined chrome allows savings three ways: (1) The alloy has a lower price due to economies in oxygen blowing ferrochrome. (2) Reduced carbon and silicon contents allow greater use of this low-cost chromium in the charge. By using more refined chrome in the charge, less chromium as low-carbon ferrochrome is needed later in the heat. (3) Less lime is needed to neutralize silica formed during decarburization. (The lower silicon content of the alloy forms less silica.) For more information, call your UCM representative or write for "Even Alloys are Oxygen Blown" in the Summer 1961 issue of UNION CARBIDE METALS REVIEW.

For more information circle 152 on page 127

* * *

MORE STAINLESS SAVINGS -- Stainless foundrymen are making big savings by using ferromanganese-silicon for finishing additions of silicon and manganese. Assuming 100 per cent recovery, $2.86 per ton can be saved for a 1 per cent manganese and accompanying 0.45 per cent silicon addition. The alloys replaced are electrolytic manganese and ferrosilicon. Several foundries also report getting cleaner steel when using ferromanganese-silicon. Write for F-20,093 for further information.

For more information circle 153 on page 127

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SILICON IMPROVES ALUMINUM CASTINGS -- Almost all aluminum castings contain silicon. The element improves castability, allowing adequate filling of thin sections and complex shapes. It also lowers the coefficient of thermal expansion and reduces hot shortness and cracking. A choice of six grades of "Electromet" silicon metal are available for additions to aluminum casting alloys. For more silicon data plus how the auto industry uses silicon in castings, write for the article, "Aluminum Auto Castings Grow," in the Fall 1960 issue of UNION CARBIDE METALS REVIEW.

For more information circle 154 on page 127

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VANADIUM...PUTS MUSCLE IN IRON -- About 0.10 to 0.15 per cent vanadium increases the strength of cast iron by 10 to 25 per cent. It also adds toughness and produces uniform hardness in heavy sections. Vanadium cast irons are therefore used in steam and diesel-engine parts, dies, and rolling-mill rolls. For additions to cast iron, Union Carbide Metals offers a special foundry grade of ferrovanadium that has good solubility in iron. Contact your UCM representative for more information. Also, ask for the article, "The Elements That Surround Us: Vanadium," in the Summer 1960 issue of UNION CARBIDE METALS REVIEW.

For more information circle 155 on page 127

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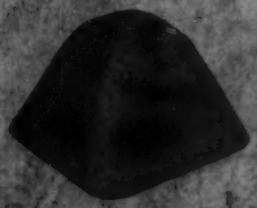

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Whither?
. . . Jobbing Foundries
. . . Mechanization
. . . Quality Control

In the May issue of MODERN CASTINGS, *our Metalcasting Trends Panel reported three timely developments of great importance: The strong division of opinion on captive versus jobbing foundries, the increased emphasis that quality control would receive this year, and the pronounced trend toward more foundry mechanization.*

With these developments in mind, Editor Jack Schaum buttonholed key metalcasters at the 65th AFS Castings Congress in San Francisco. His purpose: To get candid opinions on these vital subjects with the nation's top metalcasting event of the year as the backdrop. Here is a summary of today's thinking.

ON-THE-SPOT-OPINION

BOTH JOBBING AND CAPTIVE foundries are here to stay. They will operate in the markets they serve best. Neither jobbers nor captives feel that the other represents serious competition.

Parent companies operate captive foundries to mass produce specialty lines of castings suited to their particular needs.

Jobbing foundries specialize in custom engineered castings tailored to meet a wide variety of customer specifications.

In summary, this is the thinking of key metalcasters who attended the 65th AFS Castings Congress.

Just as the specialist competes with the mass marketer so can the jobbing foundry compete with the captive foundry for small lot orders—and gets them.

Some metalcasters say that business for jobbing foundries will increase as many companies close down their captive operations. In such instances, a parent company has usually "milked" its foundry. Equipment has been permitted to run down; then it is scrapped. When this happens the parent company turns to the open market and buys from jobbers.

The trend from captive steel foundries is strong—probably because large capital outlay is required to produce steel castings economically. Today's aggressive competition between steel jobbing foundries means the customer can get better quality at lower prices than he can achieve in his captive shop. Also, he may get a newer-type of casting. For instance, Clayton Russell, sales manager, Phoenix Iron Works, Oakland, Calif., reports: "We are stimulating business through an engineering development program. We redesign such items as manhole covers, fire hydrants, pipe fittings, and other municipal castings. Then we sell the city engineers on specifying this improved design for future installations."

Brass and bronze high pressure valves, valve seats, and pumps for oil field service are all custom engineered projects best handled by a highly skilled jobbing foundry.

Captive shops display confidence in the future. If the parent company prospers then so do they. Usually this means more funds allocated to the foundry for modernizing. Significantly, *most modern foundries in the country are captive operations*—automotive, farm equipment, machine tools. With modern equipment and topflight technicians, better quality castings at a lower price are usually produced.

Business does not come automatically to captive shops. Eric Welanders, John Deere & Co., E. Moline, Ill.. points out: "The foundry engineer must continually convince the design engineers of the parent company that castings can do the best job for the least money. The trend in our company toward more powerful tractors and bigger equipment means that we have to make higher strength castings."

Captive shops have their problems. A piston ring foundry finds its production slowed by the development of six-cylinder automobile, and use of a stamped steel top ring instead of a casting. This problem is

← Circle No. 149, Pages 127-128

"Captive shop growth is tied to the success of the end product" . . . John Van Haver

"Foundry engineers in captive shops must keep parent company sold on use of castings" . . . Eric Welander

"Steel jobbing foundries are not being hurt by captive competition" . . . Ross Williams

being countered by having the captive foundry enter a new market, making pressure and cover plates. This is a field particularly suited to this foundry's capabilities.

In the past, a captive foundry was often built because the parent company was unable to buy castings with consistent quality. But, today, there are hundreds of jobbing foundries able to meet buyers' needs.

Although there may be fewer foundries today, their casting capabilities are far superior to those of 10 or 15 years ago. They are continuing to improve at a rapid pace thanks to new technology.

Resistance to Mechanization

Although bellwether metalcasters are moving as quickly as possible towards mechanization (See page 45, May issue), many foundrymen attending the Congress endorsed a step-up in mechanization reluctantly.

Some foundrymen pointed out that amortizing the capital investment is a serious problem. Equipment may become obsolete before it is paid off. Slow business conditions can upset the amortization schedule. Many mechanized foundries must run close to full capacity before the operations are profitable.

By holding back on capital equipment purchases, a number of metalcasters say more funds are available for emergency reserves to tide the foundries over in slack business periods. They emphasize that liquid assets are more helpful than idle equipment.

Also operational flexibility is often a "must" these days because customers want fast delivery on smaller quantities than heretofore. They want to hold inventories to a minimum. Short runs of a variety of cast parts are not suitable for highly mechanized foundries.

Labor Is a Problem

Another problem is labor. Some foundries are thwarted by restrictive day-rate labor agreements which limit production. They can only use mechanization on a minimum basis. For instance at the James Foundry, Ft. Atkinson, Wis., they have a sand muller, front-end loaders, overhead hoppers, lift-trucks with self-dumping tote boxes, monorails, hoists, and pallet conveyors.

Pelton Steel Castings Co., Milwaukee, achieves mechanization by using an overhead sand distribution system, sandslinger, gravity pallet conveyors, and oscillating conveyors.

Caught between rising labor costs and customer demands for better quality castings at the same or lower prices, many foundries are being forced to more mechanization.

This is further compounded by customers holding down inventories. Now they order later and want faster delivery. With lead time now two or three weeks, instead of six or eight weeks for delivery as in the past, foundries must turn to more mechanization or lose business.

A shortage of skilled molders is also driving foundries to mechanization. Mechanization not only saves labor but eliminates problems which skilled labor creates. It removes dependence on specialized skills, and helps maintain product uniformity. Also machines can produce more per square foot of floor space than individuals. This is a boon to foundries that can't expand facilities using present property.

Is Over-mechanization a Threat?

What about over-mechanization? One metalcaster said that their foundry is seeking 50 per cent mechanization with installations that will pay for themselves in two to six pears. Some feel that such equipment should pay for itself in three, four, and five years. Others say as low as 18 to 24 months.

At Sealed Power Corp., Muskegon, Mich., 17 pour-off men were eliminated by a new electric induction holding furnace. And its new semi-automated mold blowing machines have increased molders productivity by 500 per cent.

Chester Malley, president, Stuart Foundry Co., Detroit, reveals: "Our modernization and mechanization planning has been substantially aided by building a three-dimensional scale model of our foundry. Each piece of equipment is easily moved around when we are planning changes. Then we know how a new set-up will look before we make any changes or buy equipment. It's a real time and money saver."

"Mechanization is the answer to getting more production from the floor area" . . . Dominic Meaglia

"Mechanization helps to maintain uniformity in all casting variables" . . . Chester Malley

"Rising costs, higher quality, lower price force mechanization" . . . Robert Mittlestead

Customers are demanding quality castings as never before, in the opinion of many attending the San Francisco Congress. This is why quality control is the guiding discipline in every successful foundry today. It is the key to making every casting identical.

No Compromise with Quality

"You can't compromise quality. It has to be built into a product, not painted onto it. Quality starts with management. As a result we have raised the quality of our foundry operations to a point where castings are scrapped rather than repaired," says Frank Shipley, Foundry Manager, Caterpillar Tractor Co., Peoria, Ill.

According to Jake Maenza, Dee Brass Foundry, Houston, Texas, quality control starts with the raw materials and carries through every operation performed to produce a finished casting. Dee Brass has rigid purchase specifications for all raw materials. Brass and bronze ingot is made to meet special high quality specifications because commercial specifications are not precise enough.

Another metalcaster reports that his company has four fulltime men controlling metal quality. Five others for sand, molding, and casting. A part of this expense has been offset by a marked reduction in scrap rate.

Quality Control at the Source

Rather than investing in a quality control department, some foundries train supervisors to be quality minded. By giving conscientious supervisors responsibility, defective workmanship can be spotted at the source and be quickly corrected. This is far better than discovering a defective casting hours (or even days) later.

Probably the most critical standards of perfection are being met by castings going into nuclear submarines and aircraft carriers. In making castings for atomic submarines super-quality control is exercised at all stages of production. Specifications are tighter and alloys are controlled to closer chemical tolerances. Within 24 hours after pouring, the chemical and physical properties of each casting are certified.

At Electric Boat Co., Groton, Conn., complete visual records on each casting job are made by minute camera photographs. Some 12,000 pictures completely document pattern contruction, gating, risering, etc. Photos are supplemented with a written log detailing metal temperatures, sand mix, and molding procedures.

"Our files hold 12,000 photos which are necessary to maintain quality control" . . . S. W. Chappell, Jr.

In nuclear systems casting must pass 100 per cent x-ray and dye-penetrant tests. They must be perfect to withstand the fatigue stresses imposed by pressure fluctuations accompanying variations in depth of submersion. The successful application of castings in these rugged applications are a testimonial to the effectiveness of quality control today.

Creative Sales Engineers Are Key to Today's Profits

Ruf—"The impact of automation is yet to be felt!"

New technological developments can help. But Management must lead the way through sound plant operating policies, good training programs.

The great need is for better sales engineers—the imaginative type. They are the ones who can spot product possibility.

Seminar Participants

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Houston, Texas

Lew Durdin, President
Dixie Bronze Company
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Samuel D. Russell, President
Phoenix Iron Works
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Warren C. Smith, President
H & S Metal Products Co.
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NEW TECHNOLOGY can be a powerful sales tool. It can produce more profitable sales and expand markets. It can develop new markets. But success mainly depends on three key factors:

1. How well management recognizes and defines the sales and market potentials of the new product or process.

2. How *soon* the sales department is alerted and fully informed about the new product or process.

3. How well the salesmen are equipped to sell creatively.

Too often one or more of these essentials is overlooked when an important technological innovation is introduced. Then, instead of being used as a sales tool, the new technology merely becomes a handicap. Valuable time and many sales are lost through no advance planning and no sales training.

Many types of help are needed today—by management and by the sales engineer. Much of this revolves around providing information which can help make sales decisions. In fact, the future of metalcasting depends on developing markets. Too much cannibalism ex-

Hall—"The survival of the foundry industry depends on developing new markets."

ists. Too many foundries live off each other. New technology can help. But creative selling must set the pace.

This is a concensus emerging from the First Invitational Metalcasting Seminar held by MODERN CASTINGS. Highly successful, it was staged at the 65th AFS Castings Congress at San Francisco last month. Ten leading metalcasting executives participated. Each was chosen for his special talents and ability to consider the areas under discussion: New technology and its relation to sales, creative sales engineering, and market development.

It was brought out that two important barriers to producing sales through new technology are:

1. The reluctance of metalcasters to adopt new products or processes soon enough. (Often potential business is lost to more aggressive competitors.)

2. The need for metalcasters to recognize the almost immediate benefits coming from new technology *once it is applied on a practical basis.*

Today the profitable use of new technology, in the opinion of the seminar participants, depends on: (a) making better products cheaper, or (b) making better products that bring greater profits, *but at a higher selling price.*

There is always a reluctance by customers to make a buying decision, even when the values of a new technological application are apparent. Some always think that a competing metalcaster can make their products a bit better. Surprisingly, many customers and potential customers today *are not price shoppers.*

There is a pronounced trend to requiring quality and product reliability. This is where the creative sales engineer comes in. It is his job to sell product superiority, and to prove it.

This requires careful training and continuous information. There's no standing still in the metalcasting business today, in the opinion of the seminar participants.

"Maintaining the status quo is going backward," declares one seminar member. "Either you are in the metalcasting business for keeps, or you're out of business."

"You haven't seen anything yet!" says another. "The impact of automation is yet to be felt. There will be less machining but prices paid for castings will go up."

Still another seminar member believes more man hours will be put into making castings than ever before in many product areas.

There is a growing emphasis on value purchasing rather than price buying. The sooner a metalcaster recognizes the shift from pricing to quality and product reliability, the sooner will his competitive position improve. *This will take capital investment and planning—many dollars and bold, well-calculated decisions.* But the net effect should be good for individual metalcasters and the industry as a whole.

The trend to quality casting (at higher prices in many instances) must be matched with skillful creative selling. This means:

. . . Building up a company image of quality and competence.

. . . Doing more group selling. (Getting the purchasing agent to bring his company's engineers and other executives into the purchasing act.)

This means that the metalcasting salesman must sell more ex-

Moore—"New technology leads to sales you wouldn't otherwise make."

pertly than ever before. He can only sell what his company makes. And he must know what they can do. But now it is up to him to seek out design applications and possibilities. Today a good castings salesman must discover where his customer can benefit by redesigning fabricated components into metalcastings.

In turn this means metalcasters must pay special attention today to their sales engineers—their selection, training, and technological know-how.

From opinions expressed at the seminar, it appears that much thought should be given to the *development of creative sales engineers.* Imaginativeness must be recognized as an important part of the sales engineer's makeup, *if he is to discern new casting applications.* Most engineers do not fit into this category. They're too practical and not creative. As one seminar member put it: "The best creative salesmen are Liberal Arts graduates."

The importance of the sales engineer today was summarized by another seminar participant—an AFS Director. He points out:

. . . Foundries with good sales engineers can save customers thousands of dollars through proper casting design. It is possible then to achieve more economic foundry production and to lower pattern costs. New methods can be sold which give customers better products at lower unit costs.

. . . A good sales engineer not only makes his efforts profitable but also benefits the entire industry.

. . . A satisfied customer tends to design his future products along the same line. *This creates more work for metalcasters.*

The home plant from which the sales engineer operates is important. This means new technology. This means fundamental operating policies designed to improve both plant and industry activities. These include:

1. Giving constant attention to lowering costs.

2. Producing more castings per man hour, but improving quality at the same time.

3. Paying constant attention to casting quality.

4. Using mechanization where possible, especially to replace labor that is not always available when needed.

5. Improving working conditions to attract higher types of help. In turn, this will result in better castings.

A combination of aggressiveness, good management, creative sales engineering, sound operating policies, and new technology can lead to more sales and greater profits. Only by applying the latest technology can metalcasters meet customer requirements today. Through creative sales engineering many progressive foundries are taking the initiative away from their customers. They design products for casting. When they do this new markets are developed, old ones are expanded.

But the metalcasting industry needs plenty of information and help in doing this job on an overall basis. The First Metalcasting Seminary sponsored by Modern Castings ended on this note.

IT'S AGREED!

We Must Sell Castings Harder Than Ever Before. . .

But we won't increase sales and profits unless we step up industry research and development.

There's controversy over HOW to do it. Suggestions by Simpson, Durdin, and McDonald at 65th AFS Castings Congress produce ideas, comments and controversy.

. . . Is the small metalcaster on the way out?
. . . Can old time experience and new technology fit together?
. . . Should foundries be licensed?

REACTION TO LEADERSHIP talks at the AFS New Technology sessions indicate general agreement on two points about the future well-being of metalcasting.

1. Research and development efforts must be greatly increased if the industry is to be competitive and not lose ground.

2. More sales and profits cannot be realized unless greater attention is paid to sales methods and techniques.

Producing the most sparks at the Congress was a talk at the Malleable Iron Round Table by Bruce L. Simpson, president, National Engineering Company. In essence, he said:

". . . Our problem is not over-expansion, but rather under-consumption; not that of producing too much, but of not selling enough.

". . . Progress of the foundry industry based on research and product improvement in the last 15 years has been nothing short of miraculous . . . in the next 5 to 10 years we will see:

. . . Much larger foundries with less man hours per mold.
. . . Much less manual labor—even less so-called skilled labor and many more expert technical men.
. . . The practical elimination of the small, all-purpose foundry and increasing trend toward large, highly-specialized shops.

". . . progress (in the form of research and development) has come almost entirely from the companies who supply the foundry industry, not from the industry itself.

". . . what is badly needed and must be done, if we are to have any future, is a centralization of both research and general sales promotion which works exclusively for *all* foundries, regardless of metal, type or kind."

This thinking is seconded by M. J. Henley, vice-president, Tyler Pipe and Foundry Company, Tyler, Texas. Declares Mr. Henley: "I think we have ample evidence that Mr. Simpson's statement is correct. Research and production improvement have been far short of what is needed and most certainly are the predominating factors for our future along with a well-planned promotional sales program. The upgrading of our technical people and foundry supervision in general is a must rather than a need. It is evident we should take as a motto that we can produce superior quality, sufficient quantity, and increase our place in the industry with the proper sales promotion."

I. M. Emery, president, Massillon Steel Castings Company is equally emphatic:

"I agree with Mr. Simpson that the problem in our foundry industry is not over-expansion, but rather under-consumption. We in the steel foundry industry realize that to accomplish the latter we must, through research—both in and out of the industry with all the technical skills that we can develop in

our methods—be able to show a major improvement in the quality and tolerances of our product castings. We must get design conscious, which is the major cause of most defects in steel castings, and we must train personnel who will be qualified to properly design a casting in order to make it a uniform and dependable product for its end use. I am sure that if we are able to accomplish these objectives, the selling and marketing of castings will be much easier and will tend for an increase in markets for our product."

Taking a somewhat different view is Walter L. Seelbach, president, Superior Foundry, Inc., Cleveland, Ohio.

Mr. Simpson infers:

1. Much larger foundries with less man hours per mold. This might come to pass if castings are ordered in quantities that would justify such foundry expansion.

2. Less manual labor, and even less so-called skilled laborers and many more expert technical men.

3. The practical elimination of the small, all-purpose foundry.

"Points 2 and 3 go together because the small, all-purpose foundry will not be practically eliminated. You will always have this type of foundry to take care of the casting customers who need small runs of castings; and with the small runs of castings, you cannot mechanize your core rooms and foundry to eliminate much manual labor or, even less, eliminate skilled labor, especially in the core room . . . We could agree that in the development of improved mechanical equipment and improved materials, a good part of the credit should go to the suppliers. However, it should be pointed out without the close cooperation and advice based on actual in foundry operating experience, many of these mechanical and material developments would not have come about.

"It is our sincere feeling that the greater part of the credit for product improvement is due the progressive foundries and the work that they have done toward that end, though most the product research and resulting improvement has come about through the activity of the larger companies. To name a few: Caterpillar Tractor Co., Alcoa, General Motors, The American Brake Shoe Company, and Ford Motor. We must not overlook the creditable performance along these lines by much smaller, progressive, well-staffed operations and their research organization . . ."

Durdin Points Up Problems Caused by Soft Markets

L. H. Durdin told foundrymen at the Brass and Bronze Round Table luncheon that the problems of the bronze foundrymen in 1961 are no different than in any other year. The exception is that these problems are aggravated by lower or no-profit markets, more stringent customer demands, and a shortening of delivery requirements. *(Editor's Note: A situation facing companies in many metalcasting categories!)*

There are five key areas where foundrymen must face facts:

1. Increasing demands for better quality.
2. Claims for machine time spent on rejected castings.
3. Increasing pressure for lower prices.
4. Greatly increased "shopping" activities.
5. More requests for certificates of compliance.

This thinking brought forth a number of comments and suggestions:

License Foundries. Foundries should be licensed to operate just the same as doctors, engineers, and apartment houses. To qualify for a license, a foundry would have to demonstrate that it was capable of producing castings of commercial quality. This would eliminate the unfair competition of price-cutting operations that are now ruining the reputation of the whole industry.—W. M. Ball, Jr., Metallurgist & Foundry Consultant, R. Lavin & Sons, Inc., Chicago, Illinois.

Specialized Small Foundries. I would like to point out that half of the Connecticut foundries are small, but 75 per cent of them can produce submarine quality castings And most of them belong to AFS. An Elkhart, Indiana, foundryman has a small 15-man shop but all the big shops in town send him their jobs which require x-ray quality. And he in turn farms out his production work to the big foundries in town.—S. W. Chappell, Jr., Foundry Supt., Electric Boat Div., General Dynamics Corp., Groton, Conn.

Learn New Technology. There's a sad dearth of participation by foundries in the many programs aimed at familiarizing them with the new technology. Every metalcaster regardless of size can use it. After all, there are small shops doing good work and large shops making poor castings. Size of shop is not necessarily the criterion for increasing casting quality.—R. P. Dunn, Technical Director, Lindberg Engineering Company, Chicago, Illinois.

Be Modern, Stay Modern. The competitive position of the foundry industry today requires the ingenuity of the old time foundryman plus the metallurgical and engineering skill of a trained technician. Modern methods of melting and quality control do permit the use of secondary metals which will result in some metalcasting savings. I do not agree that the basic problems in the foundry are any different today than in the past. We have always had to live up to the specification requirements of the times. Our slogan should be: Be Modern—Stay Modern.—A. J. Moore, Exec. Vice-President, Canadian Bronze, Ltd., Montreal, Quebec, Canada.

Know Costs, Hold Price Line. I'm sure that the foundry industry will always be faced with the operator who is strictly working for wages, who has no quality controls, no cost system, no inspection, and very little beyond a low price. Many of our problems would be minimized if we could get "religion" in the foundry industry with responsible operators who have a cost system, know what they can produce a part for and then hold the line. Then, if Mr. Customer wanted to buy it for less let him do it and let him get in trouble. It invariably happens, if you stand your ground, sooner or later he is back with his tail between his legs begging you to get him out of trouble by producing quality castings for him.—M. E. Nevins, president, Wisconsin Centrifugal Foundry, Inc., Waukesha, Wisconsin.

"Race for Space" Challenge Cited by McDonald

The "Race for Space" brings new challenges to metalcasting in the opinion of Dr. John C. McDonald, Lockheed Missile & Space Div., Lockheed Aircraft Corp. Appearing before the Die Casting & Permanent Mold Round Table Luncheon, he stressed the need to develop adequate rocket engines, fuel tanks, frames, and the many mechanical and other devices of control. The bulk of these components are made of metals, and the performance of metals is one of the primary problems.

". . . no longer is it enough to speak of maximum mechanical properties at room temperature, and maximum resistance to corrosion coupled with minimum weight. now we must concern ourselves with the physical properties concerned with the conduction and distribution of heat.

". . . while the basic metal may have suitable values through controlled polishing or controlled roughening, it is more likely that the desired values will have to be obtained through coatings of new and unexplored varieties."

Points made by Dr. McDonald included:

1. Man-made satellites now circling the earth are the most complicated automated devices ever built by man.
2. The Centaur engine is the newest most powerful rocket engine now being developed —uses H_2 and O_2 for fuel.
3. Project Rover—just now underway will heat H_2 in a nuclear reactor to be used for power in the future.
4. Tungsten is the space metal of the future—melts above 6000 F.
5. Absorption and emission of heat are important new metal properties in space environments. Also concerned with evaporation rates of metal in the vacuum of outer space. Micro-meteorite impact erodes surfaces of spacecraft.
6. Weather prediction and communication are the two most important civilian applications for earth circling satellites.

Leadership Speakers

B. L. Simpson

L. H. Durdin

J. C. McDonald

". . . Our problem is not over-expansion but under-consumption; not producing too much, but of not selling enough"—**Simpson**

". . . Bronze foundry problems are no different except they are aggravated by lower or no profit margins, more particular customer demands, and a shortening of delivery requirements"—**Durdin**

". . . No longer is it enough to speak of maximum mechanical properties at room temperature and maximum resistance to corrosion coupled with minimum weight"—**McDonald**

Response to Dr. McDonald's talk was positive and specific.

"Whole New World." Dr. McDonald has opened our eyes to a whole new world of metal physical properties that we haven't been concerned with in the past. Some of these are heat absorption and emission, evaporation rates, and micro-meteorite erosion. We may have to back up now and re-evaluate a lot of old materials that may have unsuspected properties ideally suited to meet space problems—D. L. LaVelle, American Smelting & Refining Company, Federated Metals Division, South Plainfield, N. J.

Casting Perfection. Too bad the foundry industry isn't "shooting for the moon" to achieve new horizons of progress like the space program. The "moon" in our industry is "casting perfection" and should be aimed at with just as much enthusiasm as any lunar probe. Many of the heat problems facing the space technologist are not too far removed from those worrying our permanent mold and die casters. Some of the technological by-products of space engineering may also solve problems in vacuum casting. Cobalt-60, now used extensively for non-destructive inspection of castings, was just one of many by-products of our atomic energy program. —W. Bonsack, Chief Metallurgist, Aluminum & Magnesium Inc., Sandusky, Ohio.

Rapid Change. As long as spacecraft use liquid fuels aluminum and magnesium will be operational since the fuel can be used for cooling. As foundry metallurgists we have been concerned with more mundane properties of metals. Now for space applications we must evaluate casting materials in terms of such properties as heat of sublimation and heat capacity. One never knows when a material falls out of favor when new technology may suddenly bring it back into a position of leadership—Nicholas Sheptak, Research and Development Engineer, The Dow Chemical Company, Midland, Michigan.

All this means, from opinions gathered by MODERN CASTINGS, that more than ever the metalcasting industry must focus on the technology of the future if it is to achieve more sales and profits in the years immediately ahead.

Prepare Now for Growing Magnesium Market

But it will not become important for the next two or three years. This phase of metalcasting must first adjust itself to private-business needs and standards.

There's an increasing demand for light-weight magnesium castings in automobiles, trucks, tractors, portable tools, furniture, sporting goods, and industrial machines.

The Armed Forces still requires the output of most magnesium foundries. The emphasis is in aerospace vehicles and missiles.

TODAY MAGNESIUM CASTING is slowly evolving from a military into a private-business industry. This means profit possibilities are limited for the next few years. But the long range picture is bright.

Decisions to use magnesium castings are mostly based on needs for light weight parts. Designers of aerospace vehicles shave off pounds, even ounces, at every possible contour.

Magnesium weighs only two-thirds as much as aluminum and can be cast with thinner walls.

Military applications still command the output of most magnesium foundries. Aerospace vehicles use cast magnesium fins and wings, inertial guidance supports, camera and instrument bearings, electronic housings, and panel doors. Air craft need wing flaps, wheels, engine parts, and housings.

Airborne military ground vehicles (e.g., jeeps and tanks) use magnesium for the ultimate in weight savings. Missile ground support equipment use a multitude of sand castings—the Nike Hercules tracking lens system with 3200 pounds per installation.

Commercial Use

Since dead weight requires fuel just the same as payload, it's not surprising to see commercial air, rail, and highway transportation providing a non-military market.

Growing interest in light weight magnesium on the part of automobile manufacturers offers much encouragement. The Volkswagen automobile is probably the most striking example. The Volkswagen foundry in West Germany pours about 90 tons of magnesium daily. This is more metal than the *entire* U. S. magnesium casting industry uses per day! Each car is equipped with 72 pounds of castings—a 20.5 pound crankcase, a 13.5 pound transmission bearing, and 38 pounds of miscellaneous brackets, covers, and housings. Both die casting and permanent mold techniques are used.

In this country a heavy truck manufacturer is using over 200 pounds of magnesium castings per unit. An interesting application is automotive instrument panels.

Other cast magnesium parts which have appeared on U. S. made automobiles include:

Main bearing oil seal
Transmission housing
Clutch housing
Torque converter housing
Transmission support bracket
Window control bracket assembly
Convertible top mechanism
Timing gear
Turn signal housing
Horn button bezel
Gear shift bowl
Fan spacer
Generator end plates
Oil pump
Oil filter bypass valve
Fuel pump air body
Fuel pump cover
Fuel pump diaphragm support
Fuel pump combination body
Engine fan
Defrost grill
Instrument bezel and panel
Steering column shroud, bracket clamp and cap
Starter and plates

This list could represent a market of 60 pounds per car—150,000 tons a year—10 times the current annual production!

Magnesium in Buses

In England, buses are using sand cast casings, cowls, and cooling fans. The light weight and good bearing properties of the latter application reduces fan belt wear appreciably. One model of the Ferguson tractor utilized a 52 pound sand cast transmission case and a 8.25 pound permanent mold cast gear box top. Some 600,000 sets of these magnesium castings were made.

As our daily lives become more mobile so do our needs for portable devices. Magnesium is a natural dead-weight saver when designed into such products as: vacuum cleaners, chain saws, business machines, movie cameras and projectors, sanders, furniture, and hand power tools. All are growing markets where magnesium castings have proved competitive and compatible.

In sports, the protective masks worn by baseball catchers and umpires (featured on this month's cover) indicate a fast-growing sales area. Some golf club heads are now cast magnesium. And the pleasure-boat industry is finding uses for this versatile light metal. Practically all racing car wheels are cast magnesium.

In the last five years, Pacific Light Metals Foundry has developed casting applications in sawmill equipment, power transmission line accessories, marine cargo handling gear, and heavy truck transportation equipment.

The industrial machinery industry holds promise for applications reducing friction losses and damage, power requirements and excess weight. Magnesium's rigidity and superior damping capacity make it especially attractive to machine tool builders.

In textile and printing machinery, where motion must be reversed rapidly, weight cutting is vital. The spinning drums which carry yarn must be stopped almost instantly when yarn breaks. Reciprocating bed plates for printing presses can run 50 per cent faster because of reduced inertia effected by switching to magnesium.

Hard to Ease Quality

Military dependence on magnesium has almost become a handicap to foundries seeking civilian markets. In fact, magnesium foundrymen are in a unique dilemma. They are so thoroughly skilled in producing high quality castings to meet rigid aircraft specifications that they find it difficult to change operating techniques and revise costs for commercial demands. Their quality control program, geared to 100 per cent perfection, must be eased to the less expensive statistical quality control of "tote-box" quantities of castings.

Often magnesium foundrymen price themselves right out of the commercial market because they lack the proper grasp of commercial standards. They must learn to eliminate the technical excellence required for missile quality and produce castings competitively.

There are many areas where dimensional tolerances and surface finish are not stringent. These fac-

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11 Advantages of Magnesium Castings

The list of successful applications for magnesium castings continues to grow as designers learn to appreciate and apply the beneficial properties inherent to magnesium. There are 11 good reasons for using more cast magnesium components.

1. Faster machining—twice as fast as aluminum and 10 times that of steel.
2. Lighter weight—only two-thirds of aluminum.
3. Longer tool life—four times that of gray iron.
4. Outstanding strength-to-weight ratio.
5. High ratio of fatigue endurance to ultimate stress.
6. Low gas absorption—easy to cast pressure-tight parts.
7. Long die life in die casting—twice that of aluminum.
8. Fast solidification—leads to die casting production rates as high as 700 shots per hour.
9. Good bearing properties.
10. Exceptionally high damping capacity.
11. Inexhaustible supply of raw materials—one cubic mile of sea water contains 6 million tons of magnesium.

tors will immediately lower pattern, molding, and cleaning costs.

Several metalcasters feel that the price of their melting stock—magnesium ingot—must be lower than it is now to compete with aluminum. Too often the bid price on a commercial job is just enough to make the buyer decide the weight saving is not worth the added cost. As the price gap closes between these two highly competitive metals, so will more business find its way into magnesium foundries. A recent reduction in the price of magnesium for die casting has already improved the market.

Dan Wellman, President of Wellman Bronze & Aluminum Co., emphasizes improving competitive position through careful cost analysis aimed at reducing costs without sacrificing quality. At Wellman this is done with a quality control system utilizing punched cards which certify the chemical and physical properties of the castings. Quality of each heat is assured before pouring by sending quantometer specimens directly from the melting room to the laboratory for analysis. Delivery of sample and return of results is speeded with a pneumatic tube system.

Die casters have done a good job of attracting commercial customers. As a result new markets seem to be growing at a faster pace than either sand or permanent mold production. Yet they need better alloys to compete with other materials. G. F. Hodgson, Doehler-Jarvis, reports only the thorium-magnesium, zinc–zirconium, and rare earth metals are available for elevated temperature improvement in properties. These are far too expensive to be used for commercial die castings. The industry needs alloys with improved mechanical properties at elevated temperatures in the area of 250-500 F. A 10 to 15 per cent improvement at 300 F would allow a substantial increase in the use of such parts in applications where elevated temperatures are involved.

Users Need Information

Magnesium metalcasters face a terrific hurdle in educating commercial users at the operating, engineering, and design level to use their light metal. How can this be done? By imaginative engineering and hard selling, says R. H. Burns, Pacific Light Metals Foundry. He points out that potential casting users have an appalling lack of knowledge about the advantages of magnesium. Primary producers can help by supplying basic technical information about the advantages of casting in magnesium to customers and educational institutions.

Casting sales engineers must assist customers in selection of proper alloys and guide their design thinking. Parts cannot be designed as wrought shapes and then handed to foundries to cast. A successful casting must start with a feasible design engineered to take advantage of inherent metalcasting capabilities.

Product acceptance is still suffering from the general fear of fires associated with careless handling of magnesium. R. D. Ferguson, Bendix Foundries, says we still find in the aircraft industry prime contractors who need and use magnesium but will not machine it. This sub-contracting by primes has allowed numerous small machine shops to become familiar with the many advantages of machining magnesium.

Good housekeeping and sharp tools are the best antidote for dispelling fire hazards. Users can then exploit to full advantage the fact that magnesium is the fastest machining structural material.

New Technology Leads the Way

An impressive list of recent technical developments has kept this light metal capable of meeting the most exacting of engineering needs.

Super quality control is used to meet high integrity demands of the aerospace industry, and high

Sand cast magnesium protective face mask (cover design) represents a new market. Cast by Hills-McCanna Co., Chicago.

speed spectrographic equipment gives complete chemical analyses within minutes so melts can be held on specification.

Improved sand practices such as waterless sand, high mold hardness, shell and CO_2 cores, and mold coatings have resulted in castings with high dimensional accuracy, excellent surface finish, and extremely thin walls.

New inspection devices guarantee the quality of the work before casting delivery. Dye-penetrant and x-ray inspection provide speedy reliable answers to acceptability. Elaborate electronic inspection gauges have been developed to indicate "go" and "no-go", "plus" and "minus" variations from target dimensions.

The importance of dimensional accuracy is often so acute that castings are locked into custom-designed clamping fixtures during heat treatment to preclude all possibilities of warping.

New technology has strengthened magnesium's previous shortcomings in corrosion resistance. Casting surfaces are now protected by chromating or chrome pickling (dipping in alkali chromates or dichromates). Wellman Bronze & Aluminum Co. has recently developed an electronic metal treating process. Magnesium Elektron Ltd. uses an ammonium bifluoride solution to remove cathodic impurities and leave behind a thin surface layer of magnesium fluoride. Electroplated metal, paint, and baked-on resins also impart surface protection from corrosion.

Research efforts in the last decade have brought forth considerable improvements in alloys. The use of such elements as zirconium and thorium have raised the physical and elevated temperature properties of magnesium-base alloys to new heights. J. W. Long, Magnesium Alloy Products Co., believes that the new alloy QE 22 will do more to assure the industry's future than any other development.

Predict High Yield Strength

At H & S Metal Products Co., W. C. Smith advises that recent experiments with electronically controlled centrifugal casting of a high strength magnesium alloy confirms a belief that magnesium castings may soon be produced with consistent yield strength of 30,000 psi. Such improved strength demonstrates the importance of new technology in opening up new market opportunities for magnesium.

Basic studies in fluid flow sponsored by the American Foundrymen's Society have taught foundrymen how to get clean metal into the mold, effect directional solidification, and extend feeding range of risers.

Inserts can now be cast into magnesium with good bonding. And the McCannacore process has been a technical breakthrough that now permits an almost unlimited complexity of cored hole configurations to be cast into components. Passageways for lubrication, cooling, and hydraulics are now created in this manner.

The die casting industry has benefited most recently by development of automatic metering devices. As a result, production has speeded and larger, better quality castings are now feasible. Peak rates up to 700 shots per hour have been reached with small castings; and manpower per part reduced as much as 50 per cent.

New foundry technology has rapidly brought the magnesium casting industry to its current status. It will serve as the spring-board for future progress.

HK 31A-T6 Alloy casting for use in a ramjet engine was previously made as a sheet metal assembly at higher cost.

This casting of HK 31A-T6 Alloy was tested at pressures up to 2200 psi. Unit is component designed for use in ramjet engine built by Marquardt Corp.

The vacuum technique DOES offer advantages if the die caster must meet requirements beyond the scope of regular methods. It can open significant new markets in specialized areas.

Vacuum Die Casting—A New Evaluation

Pros and Cons of Vacuum

Many pressure die casters jumped on the vacuum "bandwagon" just so they could offer vacuum die castings to their customers. They used any handy method of casting with an unspecified reduced pressure in the cavity. Many ran into trouble, additional expense and no great improvement in quality.

Under present market conditions, the average die caster may find the extra cost of producing vacuum die castings may be justified on only 5 to 10 per cent of his total volume . . .

But, on the other hand, when castings specifications are beyond the scope of regular methods, vacuum offers a small but significant margin of profit. The foundryman must evaluate his needs and potential gains intelligently or he will find himself in trouble.

The process has been commercially feasible for over three years. The major breakthrough was published in MODERN CASTINGS *in May, 1958 as "Progress in Vacuum Casting by David Morgenstern, president of Nelmore Mfg. Corp.*

At that time Morgenstern cautioned that: "Vacuum die casting is not a cure-all. It does not take the place of good die casting practice . . ."

In this official AFS exchange paper to the Institute of British Foundrymen, F. C. Bennett, Metallurgical Laboratory, Dow Metal Products Co., emphasizes one major point—the limited benefits of vacuum casting can be of value, if used for the right casting job.

New market opportunities opened through vacuum die casting must be carefully evaluated. The process is a tool for markets of specialized application but is not suitable for a broad production basis.

Customers will not pay premiums for vacuum die castings if the regular product will meet their requirements. Prudent die casters are producing by conventional means using adequate injection pressures and carefully designed gating and venting. Such a policy satisfies most of the requirements of today's die casting market at the lowest possible cost.

When applications carrying specifications beyond the scope of regular methods arise, then vacuum operations should be considered. In such cases the die can be converted to vacuum operation with the maximum hope for success. Even though the margin it provides is small, it may be enough to reach significant new markets.

Claims made for the vacuum technique several years ago caused monumental headaches. Purchasing agents expected all their problems to be solved. Many shops jumped on the bandwagon early just so they could offer "vacuum die castings" and used any handy method of casting with an unspecified pressure in the cavity.

Tests on samples supplied by various producers showed only marginal improvements due to vacuum. Physical properties were, at best, only three per cent better, and the reduction in porosity was barely noticeable.

A Different Picture than Gravity

The pressure die casting process presents a completely different picture than gravity die casting primarily because of the lack of an insulating mold coating which makes rapid filling mandatory. Runner velocities of 75 feet per second are often matched with gate velocities as high as 150 feet per second to fill the mold cavity without cold flow defects. The entire filling process usually requires less than 0.1 seconds, allowing very little time for the air to

escape. Careful attention must be paid to good mold design to keep the molten metal advancing so that the air can be exhausted through strategically located vents.

Whenever venting troubles the die caster he must have a process for removing gases from the mold cavity.

In die casting circles the question always comes up, "Why all the fuss? There is only one atmosphere of air in the die and we are using up to 600 atmospheres of pressure on the metal."

The usual reply is that trapped air may be compressed in such a manner that it causes problems which often make the casting unsalable. In an attempt to throw a little light on this argument it is interesting to go through a few calculations related to gases in the mold cavity.

If it is assumed that none of the cavity gas is vented it is possible to calculate the change in volume as casting pressure is applied. In hot chamber machines the gas in the runners is also compressed into the cavity and should be included in the calculation. Since normal zinc practice involves a rerun ratio of 1.25:1, this factor has been included. The cold chamber machine injects extra gas due to the 40 per cent space over the metal charge in the shot well. The rerun ratio is approximately 1.5:1.

An injection pressure of 1500 psi reduces the volume to 1.28 per cent of the cavity or casting volume. This represents the maximum possible gain to be realized by evacuation of the cavity.

Actual density measurements on vacuum cast zinc alloys show an increase of 0.8 per cent over conventional castings when the removal of air is only about 75 per cent effective. Calculations are supported by field experience in the case of zinc. The process should be slightly more beneficial for magnesium and aluminum alloys if they could be cast at similar low injection pressures.

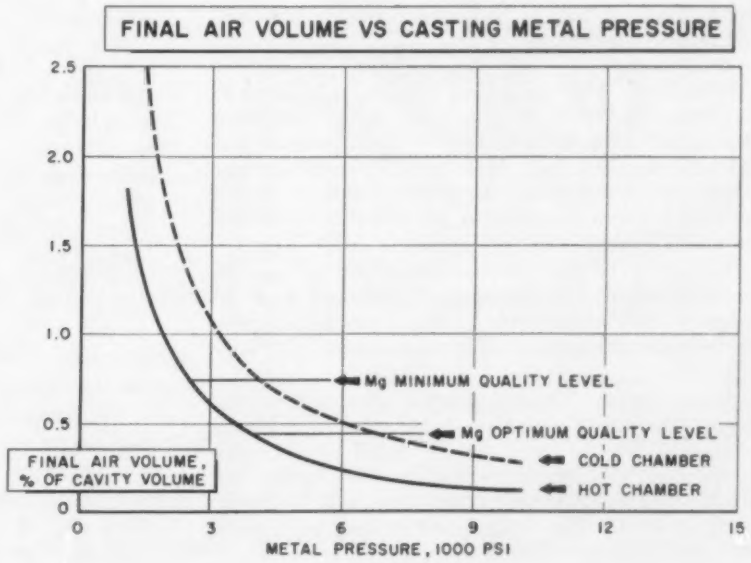
It May Not Be Worth the Money

In the graphing of final air volumes based on the tables, a "knee" appears at about the 0.75 per cent level. This corresponds with the minimum pressure levels where magnesium castings become commercially acceptable—2500 psi for hot chamber and 4000 psi for cold chamber. The data could be interpreted to mean that much of the venting technique used in die casting is ineffective. It might also mean that lubricants flash to vapor and keep the cavity full of gases during normal filling of the die.

Curves support observations that there is a minimum pressure required for each quality level except in the unusual case where perfect venting is attain-

Die Cavity Gas Compression

Based On: Cavity Volume = 1	Runner Volume = 0.25		Biscuit Volume = 0.25		Shot Well 60% Full			
Pressure on Metal—P.S.I.	1000	1500	2000	3000	4000	6000	8000	10,000
Atmospheres	68	102	136	202	272	408	544	680
Compressed Gas Volume as % of Cavity Volume								
Cavity only	1.47	1.02	.74	.49	.37	.25	.18	.15
Cavity and Runners (Hot. Ch.)	1.84	1.28	.93	.61	.46	.31	.22	.19
Cavity, Runner, and Well (C. Ch.)	3.3	2.3	1.7	1.1	.83	.55	.41	.34



Plotting of final air volumes listed in table. The "knee" which become sharper at 0.75 per cent level corresponds with the minimum pressure levels where magnesium castings become commercially acceptable. Curves indicate there is a minimum pressure on the metal required for each quality level except where perfect venting is attainable.

able. It seems reasonable that less pressure on the metal would be required to achieve a given quality level such as 0.45 per cent, or one that could reach a higher quality level with maximum pressure applied when the gas is removed prior to the filling. This gives a base for evaluating the role of vacuum in die casting.

There is a tremendous variation in pressure die casting. One shop may be injecting metal at 1000 psi and another at pressures greater than 20,000 psi. In such cases the introduction of vacuum means two entirely different experiences.

As illustrated, the low pressure example shows a maximum porosity of 1.84 per cent is possible so that the change to vacuum would be effective and desireable, despite the extra effort. In the second case where high pressures are already common, vacuum could give the same porosity level at lower pressures but it would make only the slightest improvement in quality at high pressures. Management would probably say that it wasn't worth the money.

There is also a wide variation in the degree of vacuum deemed necessary to achieve significant results. Some experts indicate that 15 to 20 inches of vacuum (14.5-9.5 inches of mercury absolute) is adequate for commercial production. Others report using 22, 24, 26, and even 29 inches of vacuum.

Experience Is Main Ingredient

The magnitude of vacuum benefits depends on previous plant experience and the degree of improvement over optimum practice is bound to be marginal. Numerous inspection trips to plants in the United States support these conclusions. Hardware finish zinc castings are being produced at least as good as the vacuum product. They are being made faster, with less die set-up time, on cheaper dies, without the space-consuming, breakdown-prone hoods, valves, seals, and other apparatus associated with the vacuum process.

If one accepts the conclusion that vacuum die casting can offer only relatively minor process improvement, the next step is to evaluate the possible significance of these gains.

Reduction in the injection pressure for a given quality level. This advantage should be realized to a degree and with it can come some increasing casting accuracy, reduction in die maintenance, and machine simplifications. Many operators will not take advantage of this gain, just as many always use the maximum pressure available on a machine whether or not it is needed.

Reduction in concentrated porosity. This will be most significant for hard-to-vent castings as well as large cavities which favor localized gas pockets due to the flow of metal. It will not eliminate shrinkage porosity.

Better surface. There is general agreement on this point. It is easy to see how the absence of a barrier of gas on the surface of the die could promote uniform, rapid chilling which could extend further into the casting. This explains the increased platability many claim for the vacuum cast product, and might make anodizing possible.

Reduction in general compressed porosity. When air and lubricant are compressed into a casting subsequent processing or use at elevated temperature causes blistering. The vacuum cast product will be less sensitive in making it possible to weld, braze, or porcelanize the part. Applications requiring pressure tightness might justify the use of the process.

Less oxidation of the injected metal. This is reported to help the casting of alloys containing magnesium.

Vacuum Pumps Now Available

The conditions of operating a pressure die casting machine make it somewhat difficult to evacuate the cavity gases in a practical manner. Inventors as far back as 1915 have attempted to solve the fundamental problems of charging hot molten metal into the pressure system followed by rapid evacuation of the mold and injection of the charge. The metal has to be metered accurately and stopped short of the vacuum system.

Vacuum pumps are now available to do the job reliably as long as suitable traps are utilized to collect entrained solids. Vacuum cut-off valves are a different matter, however, because they must have full port area and very fast action to be effective. In addition to these requirements the valves must function for hundreds of thousands of cycles without serious maintenance problems. For these reasons many inventors have designed their own valves.

The mold itself offers some design problems if it is to be used effectively for vacuum work. Leakage of air or lubricant around the ejector pins will largely nullify the beneficial effects of vacuum, making it necessary to either seal each pin or the entire box assembly at the back of the mold. Also, the parting plane should be closed by a seal adequate for pressures and temperatures. Since there is one atmosphere of pressure across the seal it must be very rugged or the vacuum must be broken before the machine opens. Water lines create a real problem. There is no general solution except to make the best compromise in each individual case.

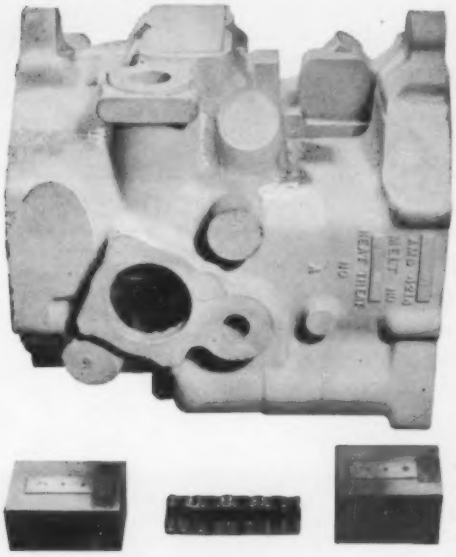
Hot chamber zinc machines require only relatively minor modifications of the injection apparatus for the vacuum cycle. The main difference is that a seal must be established at the inlet port of the gooseneck so the pressure of the atmosphere will not push the metal from the holding pot into the die when mold evacuation occurs.

Most cold chamber machines now use a short tube leading from the pot of molten metal to the shot well. The vacuum creates a difference in pressure sufficient to cause the liquid metal alloy to rise from the pot into the shot well. By timing the flow through an orifice or tube of definite size the proper charge can be metered for each injection cycle.

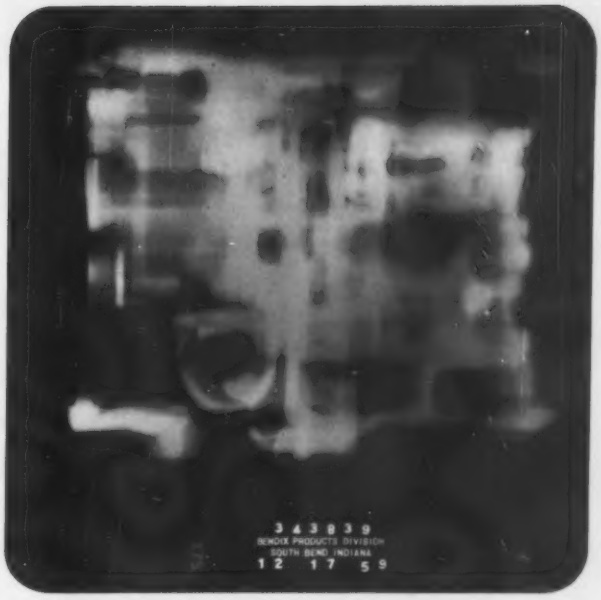
The average pressure die caster who installs the vacuum process soon finds that he has increased the complexity of his equipment leading to higher operating costs. Under present marketing conditions, the extra cost may be justified on only 5-10 per cent of his total volume.

ITS JOB:

Watching the diet of hungry jets



Casting for jet engine fuel control valve made by Bendix Products Division, South Bend, Indiana.



Radiograph of casting showing soundness and condition of internal passages.

A maze of passages and channels, this intricate casting becomes a jet fuel control valve. Bendix checks the soundness of the body and clearness of the passages with Kodak Industrial X-ray Film.

FEEDING 2500 gallons of fuel an hour with precise control is the task for this casting. It will be machined to infinitesimal tolerances and then precision fitted with valves and controls. Is the casting sound? Are wall thicknesses correct? Are internal passages clear? Bendix Products Division, South Bend, Indiana makes sure with radiography.

Radiography is the one means of non-destructive testing that not only inspects internal conditions but provides a record of the findings.

Producers of castings and makers of welded products use radiography to make sure that only quality work is delivered—a means of building a good reputation and increasing business.

Radiography may be important in your work, too. Why not discuss it with an x-ray dealer—or write us for a Kodak Technical Representative to call?

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Circle No. 151, Pages 127-128

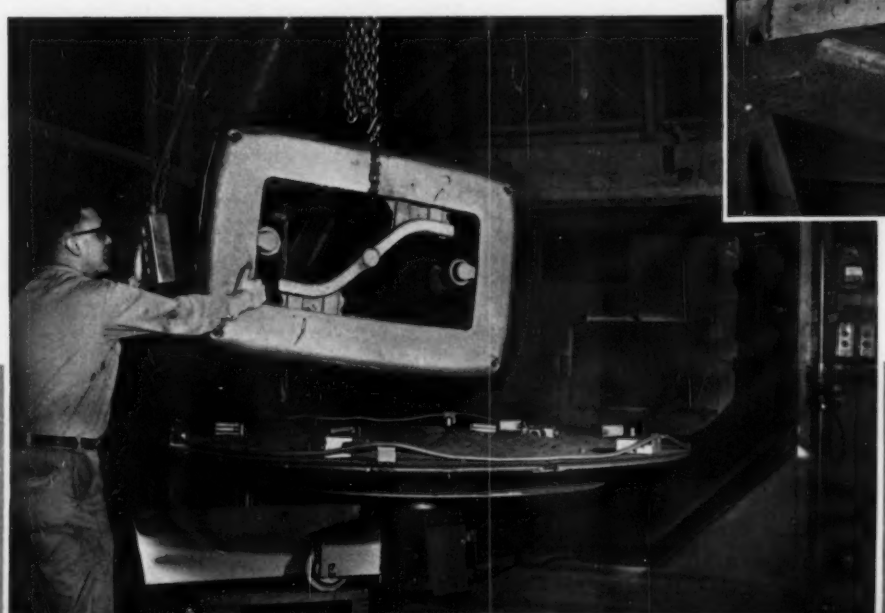
here's PROOF of

PHOTOS AND STATEMENT FROM

Ingot mold flask (for steel mill use) weighing 18,500 lbs., being inspected by Metal Blast's abrasive engineer, *prior* to blast cleaning with "SUPER-STEEL" shot.

The W. S. Hodge Foundry has been in continuous operation for 85 years — serving the industry with highest quality gray and ductile iron castings since 1876.

Ingot mold flask weighing 11,300 lbs., *after* cleaning with "SUPER-STEEL" shot.



Ingot mold hot top cover, 493 lbs., *after* cleaning with "SUPER-STEEL" shot.

"SUPER-STEEL" performance!

SHOT OR GRIT

THE W. S. HODGE FOUNDRY, GREENVILLE, PENNA.

The *unretouched* photos on the opposite page, taken recently in the HODGE FOUNDRY, should go a long way toward proving that "SUPER-STEEL" is doing an outstanding job of cleaning castings. For further affirmation, please read what W. S. Hodge has to say about their experience with this fine abrasive:

> ***"Metal Blast's "SUPER-STEEL" has substantially reduced costs on our blast cleaning operations over the steel shot we were previously using. We are very pleased with the cleaning and appearance of our castings and well satisfied with the abrasive engineering service provided by Metal Blast. We highly recommend "SUPER-STEEL" to all foundries interested in saving on their cleaning costs."***

If you're not entirely satisfied with the performance (or cost) of your present steel abrasives, why not try "SUPER-STEEL"? In addition to the excellent performance and service referred to above, you'll get greater "resistance to breakdown" and lower maintenance costs — yet you pay less for "SUPER-STEEL"! You can't help but cut cleaning costs — in fact, we'll guarantee it! Write, wire or phone collect — we'll rush a trial order, test sample, more information or have our abrasive engineer call

"SUPER-STEEL" SHOT or GRIT

$165.00 PER TON TRUCK LOADS

Packed in 50 or 100 lb. bags, steel drums, pallets.

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Circle No. 161, Pages 127-128

AFS New Technology-1961

July Contents

Gray iron foundrymen can eliminate excess mold wall movement in inoculated iron poured in green sand molds through the use of rigid molds such as dry sand or core sand molds. Page 63

The industry must face one important fact: many engineers, designers, and buyers are afraid of castings. We must lead the parade, not take a back seat to better promoted forming processes. Page 73

On-the-spot results of hydrogen content in aluminum melts greatly improves quality control by providing foundrymen with gas level data before the start of pouring operations. Page 80

Determination of molding sand toughness represents a new property for checking sand acceptability. How sand forms to a molded mass is related to the production of quality castings. Page 84

Steel foundrymen can quickly and effectively reduce the sulfur content of medium carbon and medium alloy steel with a six-point program which cuts levels down to 0.002 per cent. Page 90

On the next 32 pages are five selected new technology break-throughs announced in 1961. They appear for the first time in detailed form. (See pages 69 to 84 in the May issue of MODERN CASTINGS for exclusive interpretive summaries —published for the first time in any magazine this year.)

New technological breakthroughs will be revealed in detail during 1961. Some 28 have already been preprinted first in MODERN CASTINGS prior to public presentation at the 65th Castings Congress, May 8-12.

The 105 Breakthroughs represent the most important new technological advances in metalcasting. They have been authenticated as new contributions by metalcasting experts serving as a 600-man technological committee. This group is guided by a member of the editorial staff, S. C. Massari, AFS Technical Director.

In addition they are evaluated further by MODERN CASTINGS editors for their significance as practical tools today. Written comments or criticisms of these articles will be included in the 1961 AFS TRANSACTIONS if submitted before September 15.

SOLIDIFICATION OF GRAY IRON

Progress Report
Gray Iron Division
Sponsored by
AFS Training & Research Institute

by H. D. Merchant and J. F. Wallace

ABSTRACT

The work on gray iron solidification described herein was undertaken as a portion of the project on gray iron risering sponsored at Case Institute of Technology by the AFS Training and Research Institute and performed under the direction of the Research Committee of the AFS Gray Iron Division. A previous progress report[1] submitted on this project indicated that more mold wall movement was obtained in green sand molds with inoculated than with uninoculated gray iron. The investigation described here and other work on the influence of inoculation and the eutectic cell size was conducted in an attempt to determine the reasons for the variation in mold wall movement behavior resulting from inoculation. This has been written, along with another report describing the effect of inoculation on eutectic cell size, to present some reasons for the behavior of inoculated and uninoculated iron.

INTRODUCTION

From a commercial standpoint, gray irons within a range of carbon equivalence of 3.8 to 4.2 per cent are the most important. Accordingly, an iron with a carbon equivalence of about 4 per cent was selected as a typical iron for this investigation. Since the acid-lined cupola is the most commonly employed melting facility, iron from a hot-blast, acid-lined cupola was utilized. The selection of this source of molten iron is significant because of the known influence of melting procedure on the solidification behavior of gray iron.

Iron with a carbon equivalence of 4 per cent starts to solidify as primary austenitic dendrites and completes the solidification as an austenite-graphite eutectic. The addition of effective inoculants exerts a marked influence on the solidification behavior of the austenite-graphite eutectic, as discussed in a number of recent articles on this subject.[2-18] Effective inoculation can be obtained by a number of additions. An 85 per cent silicon grade of ferrosilicon containing appreciable aluminum and calcium was selected for use in this work because it is known to be an effective inoculant in this type of iron.

The investigation involves both thermal and quenching studies during solidification of inoculated and uninoculated gray irons. The thermal studies serve to show thermal gradients and periods of solidification in the castings. The quenching of castings during solidification is more reliable than thermal studies, however, in following the progress of solidification throughout the casting.

PROCEDURE

The castings utilized in this investigation were a cylindrical bar 2 in. in diameter and 8 in. long, and a short square cross-sectioned bar 4 by 4 by 6 in. long. The longitudinal dimensions of the castings were so chosen that the temperature measurements at mid-length cross-section were not significantly influenced by heat abstraction from the ends. The cylindrical castings were small enough to be cooled rapidly by quenching in water. The cylindrical casting was horizontally cast with a blind riser located at one end and connected to its main body with a riser neck.

The square casting was vertically cast with an open riser positioned directly on the top. Riser and riser neck were dimensioned according to formulas listed in a recent progress report of this gray iron risering work, and were designed to be adequate for the size of casting and type of iron poured.[19] The cylindrical casting was single gated tangentially into the riser, while the square casting was single gated from the bottom of the casting. The gating systems were designed utilizing optimum pouring times, and were dimensioned according to the recommendations incorporated in another recent report.[20]

Four heats of castings were poured for which the iron was melted in a commercial, hot-blast, 54 in. diameter cupola and transferred to a holding ladle. The iron was tapped from the holding ladle into preheated hand operated ladles suspended from a crane and transferred to small 50 lb pouring ladles before pouring into the molds. The cupola charge consisted of various amounts of pig iron, steel and gray iron with small amounts of silicon carbide and ferrosilicon.

The approximate cupola tapping, holding ladle tapping and pouring temperatures were 2800, 2650

H. D. MERCHANT is Rsch. Met., Owens-Illinois Glass Co., Toledo, Ohio and J. F. WALLACE is Assoc. Prof. Met. Engrg., Case Institute of Technology, Cleveland.

Members of the Research Committee of the AFS Gray Iron Division are: J. S. Vanick, *Chairman*, R. A. Clark, W. O. McFatridge, J. E. Rehder, D. Sanner, W. Edens, C. F. Walton, K. F. Echard and S. C. Massari.

and 2550 F (1538, 1460 and 1404 C), respectively, as determined by an optical pyrometer. Care was taken to control tapping, inoculating and pouring temperatures as closely as possible. Such control of these temperatures is essential because of their observed influence upon the mode of solidification.[4,21] The final chemical composition of the heats is presented in Table 1.

TABLE 1 — CHEMICAL COMPOSITION AND TYPE AND AMOUNT OF INOCULANT

Heat No.	Casting Size, in.	Composition, %* C	Si	C.E.**	Inoculant
1	4 x 4 x 6 long	3.19	2.16	3.91	None
2	4 x 4 x 6 long	3.02	2.66	3.91	0.5% Si as FeSi
3	2 Dia. x 8 long	3.21	2.22	3.95	None
4	2 Dia. x 8 long	3.12	2.69	4.02	0.5% Si as FeSi

* All heats contained about 0.085% sulfur, 0.55% phosphorus and 0.80% manganese.
** % Carbon Equivalence = % C + ⅓ %Si.

Uninoculated Heats

Heats 1 and 3 were not inoculated; 0.50 per cent silicon, as 85 per cent grade ferrosilicon containing known quantities of aluminum and calcium, was added to the stream while transferring the melt of heat 2 and 4 into small 50 lb pouring ladles. After pouring into the small ladles, the melt was allowed to drop to the desired temperature before pouring into the molds. The chemical analysis of the ferrosilicon is:

Si, %	Al, %	Ca, %	Fe, %
82.54	1.96	0.92	Rem.

Fourteen cylindrical bar molds were made in green sand on a jolt-squeeze molding machine under equivalent conditions. The molds were compacted in flasks and jacketed for pouring. At least a 2 in. layer of sand surrounded all parts of the casting to prevent rapid loss of heat at any location. Similar precautions were taken in making two square bar molds. However, these molds were hand rammed and compacted in slip flasks.

Before jacketing, six Pt-Pt-10 per cent Rh thermocouples were inserted in each square bar mold, along a mid-length cross-section plane of the casting at predetermined distances from the mold surface. The sand utilized for the molds was the regular system sand employed in the production foundry having approximately 4 per cent total moisture, 5 per cent clay bond and 8.5 per cent total combustibles. Four of the six thermocouples inserted in each of the two 4 in. square mold cavities were silica sheathed and enclosed in ⅛-in. OD and 1/16-in. ID quartz protection tubes. These were positioned ½, 1, 1½ and 2 in. into the mold cavity from the vertical mold wall used as a reference plane.

In addition, two unprotected but silica sheathed thermocouples were used to measure interface temperatures on both metal and mold sides. The bead of the thermocuple on the mold side of the interface was ground flat to conform to a hemispherical shape. It was then silica-washed and positioned flush with the mold wall. Two junctions of the thermocouple on the metal side of the interface were not welded into a junction bead, but were left unattached and positioned ¼-in. from the mold interface so that the molten and solid iron would complete the circuit.

Such positioning of thermocouples has been shown to measure interface temperatures on mold and metal sides.[22,23] All six thermocouples were positioned to be perpendicular to the same mold interface. The temperatures in each casting were recorded by connecting the thermocouples to a single point recorder via a potentiometer and a ten-way hand operated switch. This arrangement had the scale range of 1500-3000 F (816-1649 C), and it permitted sequential temperature readings from six thermocouple stations within about 30 sec.

Castings Poured

Seven 2 in. diameter castings were poured from each of the first two heats. After pouring, six castings from each heat were knocked from the molds at predetermined times into a tank of flowing cold water, while the last casting of each heat was allowed to cool in the mold. The shakeout times after pouring for all castings are tabulated in Table 2. Two 4 in. square bar castings were poured from heat no. 3 and 4, allowed to solidify without moving and temperatures recorded for at least 45 min after pouring.

TABLE 2 — SHAKEOUT TIMES AFTER POURING (IN MIN)

Casting No.*	Heat 1 Uninoculated	Heat 2 Inoculated
1	3	2½
2	4	3¼
3	5½	5½
4	7	7
5	8½	8½
6	10	10
7	60	60

* All except casting number 7 in both heats were quenched in water immediately after shakeout.

After cooling to room temperature, all 2-in. diameter cylindrical castings were sand blasted and processed to obtain the desired information on structure and composition. A ½-in. thick transverse section was cut from the longitudinal center of each casting to provide for micro and macro examinations, to assess the progress of solidification at the time of quenching. The quenching procedure does not significantly affect parts of the casting which are solid at the time of quenching, but causes the remaining liquid to solidify in an easily distinguishable fine dispersion.

The photomicrographs in Fig. 1 indicate how the solid and liquid portions at the time of quench can be distinguished. The fine white dispersion in Fig. 1a is white iron that occurred in the portion of the casting that was liquid when quenched. The solidified eutectic cells at the time of quenching appear as black circles. In the castings that were quenched after solidification had progressed substan-

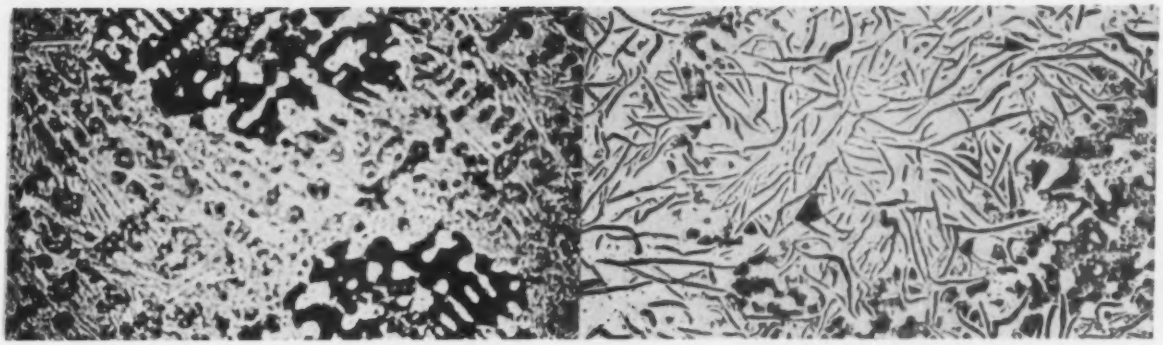


Fig. 1 — Typical microstructures of 2 in. diameter castings quenched during eutectic solidification. *Left* — (a) near outside of casting quenched soon after pouring. *Right* — (b) near center of casting quenched a considerable period after pouring. Picral etch. 100 ×.

tially inside the surface, as shown in Fig. 1b, the effect of the quench had to penetrate through the solidified skin.

Consequently, the remaining liquid in the center of the casting between the eutectic cells was cooled more slowly giving Type D graphite as distinguishable fine dispersions. The solidified portions of this bar at the time of quench appear as Type A graphite. Each speciman was examined after polishing and etching with 6 per cent picral, to determine the per cent solid eutectic.

A sampling plan was devised, to simplify the measurements of amount of solidification, in which the estimates of per cent solidified were made at a given radius on nine equidistant fields. The mean of these nine readings was regarded as an estimate of per cent solidified at the particular radius in question. The radii were so selected that they were 0.2 in. from each other in all solid and all liquid zones, and 0.08 in. from each other in mushy zones. The macrostructures of complete cross-sections of the bars were also studied, to provide further evidence of the progress of solidification in each casting. Typical macrostructures of a pair of uninoculated and inoculated castings quenched during solidification are shown in Fig. 2.

Mid-length sections from the cylindrical bars which solidified completely in the mold were employed to determine eutectic cell size after polishing and etching. From the same piece, a ⅝-in. wide, 1-in. long and ⅜-in. thick radial piece was sectioned, polished and employed to examine the microstructure from the center to the surface of the casting.

RESULTS AND DISCUSSION

Thermal Measurements

The thermal measurements of 4 x 4 in. bars are presented as cooling curves in Fig. 3 for uninoculated iron, and in Fig. 4 for inoculated iron. The cooling curves exhibit two thermal arrests in cooling rate. The first arrest occurs during the solidification of primary austenite, and the second arrest at the eutectic solidification. The thermal arrests also provide an approximate indication of the temperatures of start of primary and eutectic solidifications. However, these curves do not indicate the end of eutectic arrest as sharply.

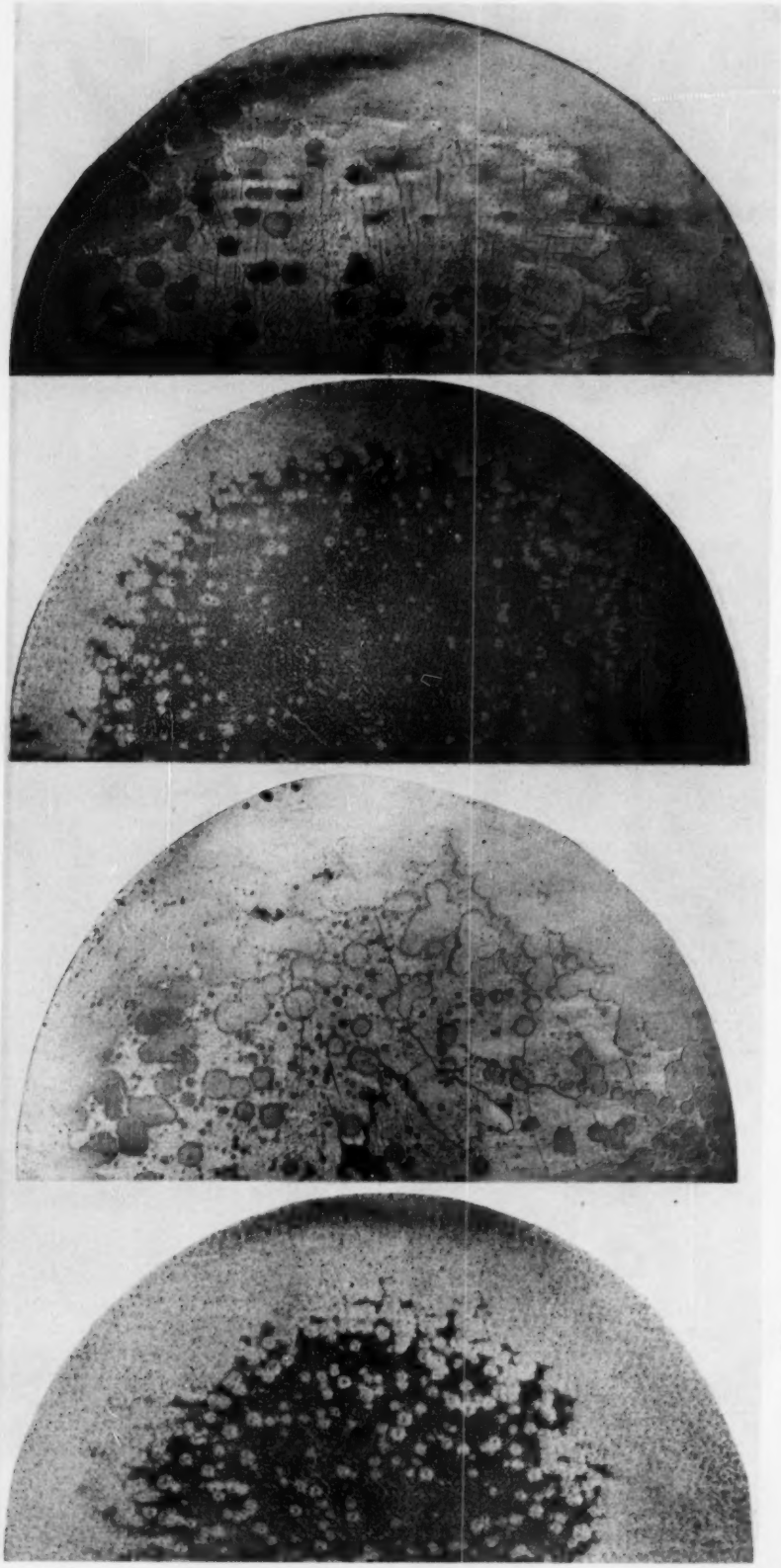
The cooling curves do not show any undercooling or recalescence usually observed, probably because of complex thermal exchanges taking place within the comparatively huge mass of the casting. The temperature of the primary austenite arrest is slightly lowered in inoculated iron due to the alloying effect of the inoculant and small change in the carbon equivalence. The eutectic arrest temperature of the inoculated casting, however, is raised by about 12 F indicating a reduction in undercooling. It is noted that this shifting of primary and eutectic arrest temperatures in inoculated gray iron reduces the temperature range over which the primary austenite solidfies.

The results of these thermal measurements are shown in Figs. 5 and 6, replotted as temperature versus the distance from casting surface at various times for uninoculated and inoculated irons, respectively. The figures provide the thermal gradients within the casting at various times during solidification. A tendency towards shallower temperature gradients is observed during the eutectic solidification in inoculated iron. This influence of inoculation on thermal gradients was expected because inoculation reduces undercooling, and has also been shown to increase the time required for eutectic solidification.[6]

Both of these factors tend to reduce the thermal gradients across the section of the solidifying casting. In addition, it has been observed[24] that the reduction in undercooling due to inoculation depends upon the solidfication rate, so that the higher the freezing rate the greater the reduction in undercooling. These factors also indicate that reduced thermal gradients occur across the section of the casting as a result of inoculation, at least at the start of eutectic solidification, since the freezing rate decreases toward the center of the casting.

Cooling Curves

The cooling curves for the interfaces at the mold and metal casting surface are plotted in Figs. 7 and 8 for uninoculated and inoculated irons, respectively. It is apparent that the difference between mold and metal interface temperatures at various instants is consistently larger for uninoculated iron. This difference between interface temperatures



a) — Uninoculated, quenched 4 min after pouring.

b) — Inoculated, quenched 3¼-min after pouring.

c) — Uninoculated, quenched 5½-min after pouring.

d) — Inoculated, quenched 5½-min after pouring.

Fig. 2 — Typical macrostructures of 2 in. bar casting quenched during solidification. Picral etch. 3.5 ×. Reduced slightly in reproduction.

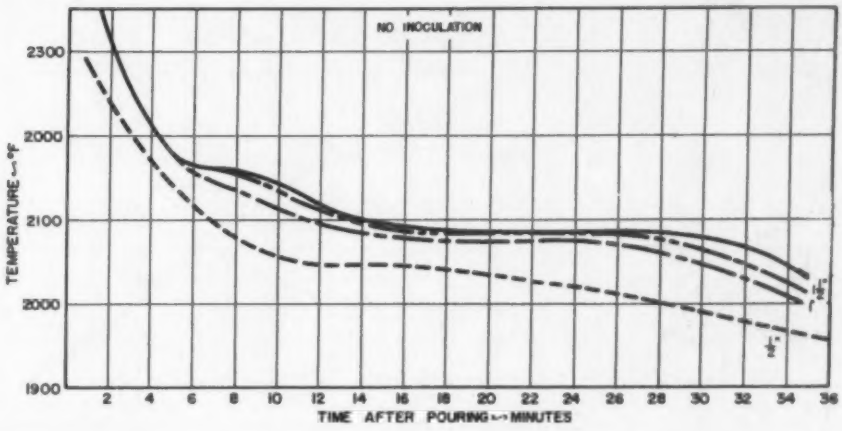


Fig. 3 — Cooling curves of uninoculated 4 in. square casting at various distances from casting surface.

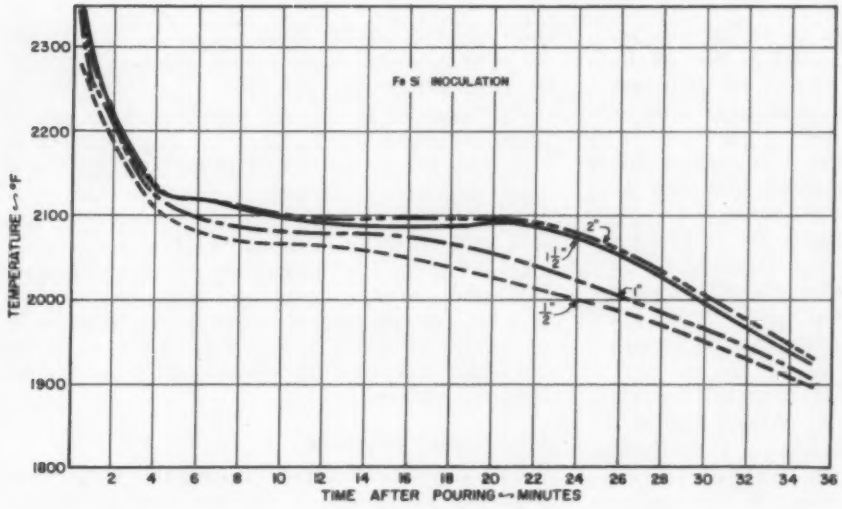


Fig. 4 — Cooling curves of inoculated 4 in. square casting at various distances from casting surface.

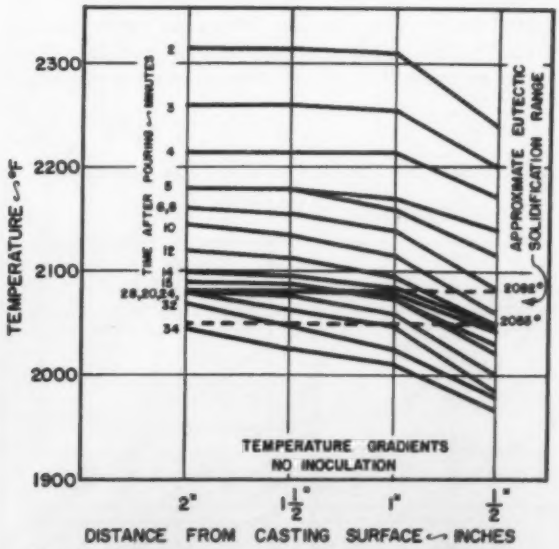


Fig. 5 — Temperature gradients across uninoculated 4 in. square casting during various stages of solidification.

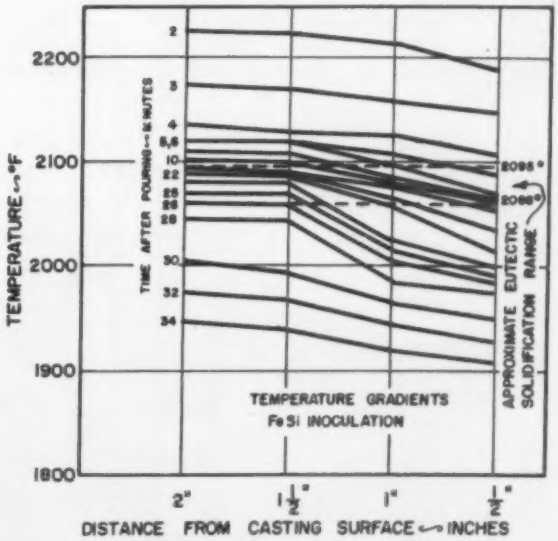


Fig. 6 — Temperature gradients across inoculated 4 in. square casting during various stages of solidification.

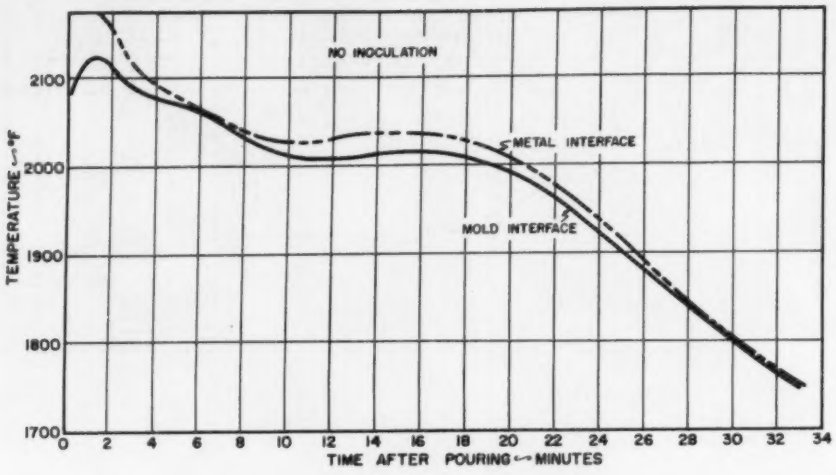


Fig. 7 — Cooling curves of uninoculated 4 in. square casting at metal and mold interfaces.

should indicate the information of an air gap between mold and metal and, therefore, it may be deduced that the air gap is not formed in inoculated iron until the solidification has progressed substantially.

In uninoculated iron, however, it appears that the air gap at the mold-metal interface is formed immediately after the start of solidification. Since the transfer of heat from the casting to the mold takes place primarily by radiation, the existence of an air gap may significantly influence the solidification rate and total solidification time, particularly in a casting where the heat transfer would occur by conducting without such a gap.

The results of the microscopic analysis of the quenched specimens are plotted in Figs. 9 and 10 for uninoculated and inoculated irons, respectively. Each curve represents the percentage of eutectic that has solidified at various distances from the surface of the casting at the time of quenching. These figures indicate the progress of solidification in both uninoculated and inoculated irons. It is evident that a completely solid skin is separated from the all-liquid interior by a fairly wide semi-liquid zone during the early stages of solidification for both types of iron. As solidification progresses, the solid skin becomes thicker and liquid zone is gradually replaced by semi-liquid, mushy zone.

The progress of eutectic solidification is plotted as isoeutectics or solidification sequence diagrams in Figs. 11 and 12, for uninoculated and inoculated irons, respectively. Isoeutectics illustrate that eutectic solidification starts throughout the whole section in a short time for both uninoculated and inoculated irons. This is particularly true for inoculated iron, since eutectic solidfication starts at the center only 1½-min after it has started at the surface.[8] By the time a solid skin ¼-in. thick has formed in the inoculated iron over 25 per cent solid eutectic has formed at the center.

Solidification Sequence

The solidification sequence diagrams reveal some important differences in the mode of solidification between uninoculated and inoculated irons. The eutectic solidification starts about one min earlier in inoculated iron, but ends essentially at the same time as uninoculated iron. Thus, no significant difference exists between uninoculated and inoculated irons as far as the solidification time after pouring is

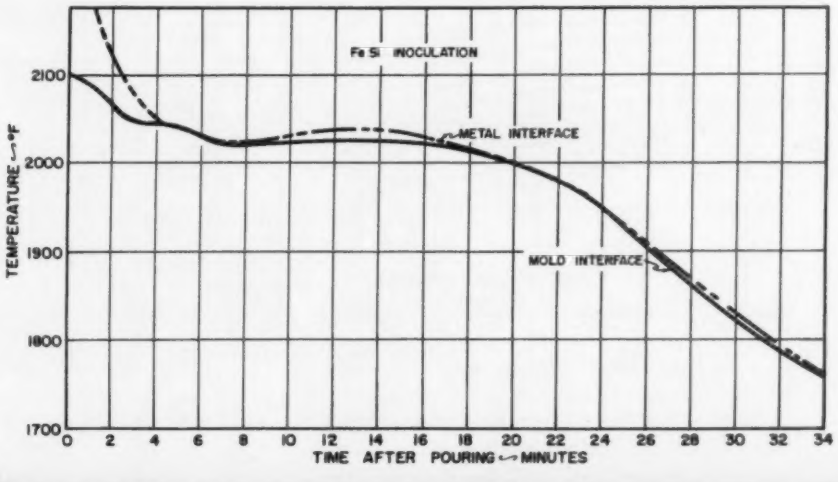


Fig. 8 — Cooling curves for inoculated 4 in. square casting at metal and mold interfaces.

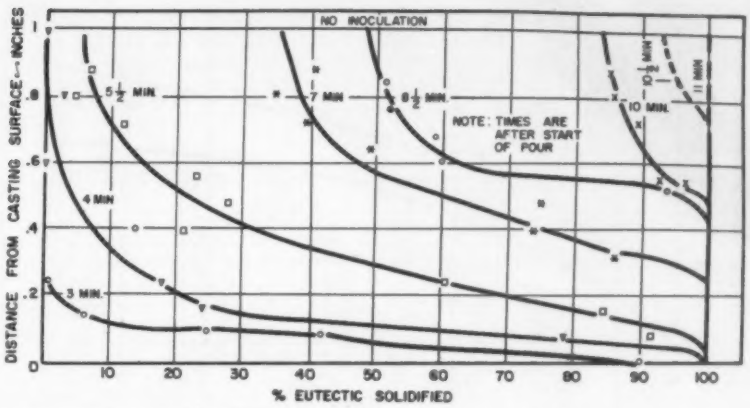


Fig. 9 — Amount of eutectic solidified vs. distance from casting surface at various times after start of pour for uninoculated gray iron.

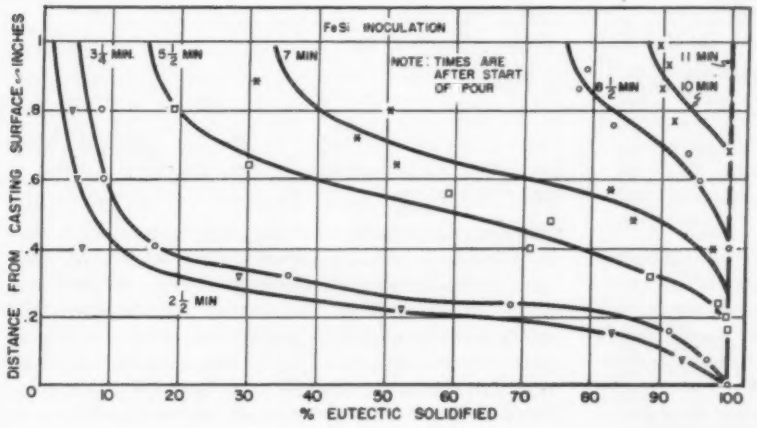


Fig. 10 — Amount of eutectic solidified vs. distance from casting surface at various times after start of pour for inoculated gray iron.

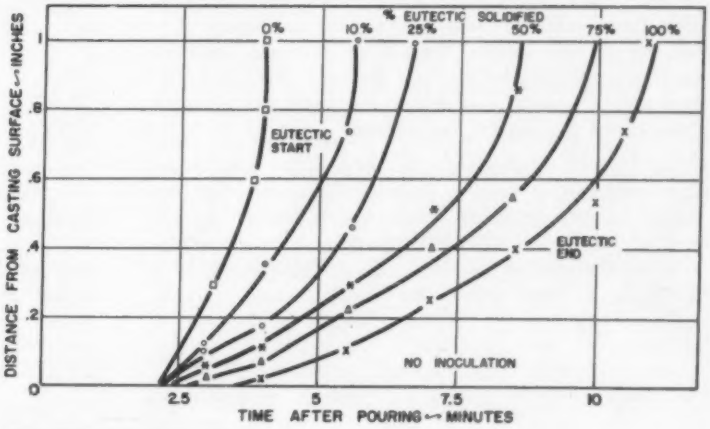


Fig. 11 — I.S.O. — eutectic diagram for uninoculated castings.

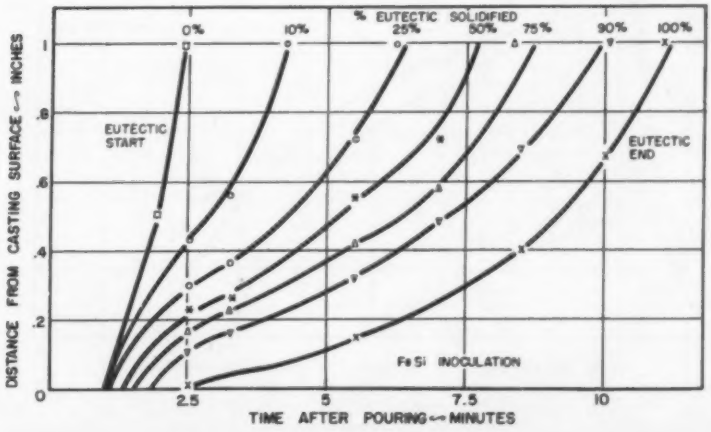


Fig. 12 — I.S.O. — eutectic diagram for inoculated castings.

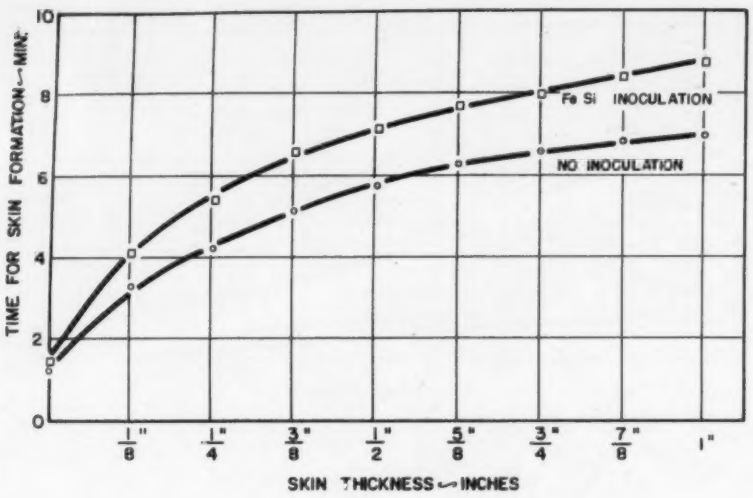


Fig. 13 — Time for formation of various skin thicknesses for uninoculated and inoculated gray iron castings.

concerned. Time for eutectic solidification in inoculated irons, however, is one min longer than for uninoculated irons. These results are in agreement with previous observations.[6]

The time required for the formation of 100 per cent solid skin or the time from the start to end of eutectic solidification at the surface of the casting is slightly higher in inoculated iron. As the skin becomes thicker, this difference in the time required for skin formation between inoculated and uninoculated irons becomes more pronounced, as shown in Fig. 13. This longer time for skin formation in inoculated gray iron has two significant effects. Resistance of the casting surface to internal pressure during graphite precipitation becomes less, and the inoculated casting continues to exert a pressure against the mold for a longer time.

As eutectic solidification progresses in both irons the mushy zone widens, reaches the center of the casting and then starts to decrease with the formation of the solid skin. The thickness of the mushy zone in the casting has been plotted in Fig. 14, with a change in time scale. The zero time scale is now the start or eutectic solidification. In inoculated iron, compared to uninoculated iron, the mushy zone is wider during all stages of eutectic solidification.

When the mushy zone attains a maximum width in uninoculated iron, about $\frac{1}{16}$-in. thick solid skin has already formed; in inoculated iron, on the other hand, no solid skin has formed by the time the whole casting section is completely mushy. This occurrence of a somewhat wider mushy zone and thinner skin in inoculated iron undoubtedly influences the mold wall movement in green sand molds.

No attempt was made to plot solidification sequence diagrams from the cooling curves, because diagrams so derived will merely be a poor approximation of the progress of solidification if it is assumed that a given temperature always represents the same stage of solidification across the whole section of the casting. Such as assumption is clearly untrue, because the solidification starts at a lower temperature at the edge than at the center because of the slower freezing rates at the latter location.[24] On the other hand, the solidification is completed at a lower temperature at the center than at the edge.[15]

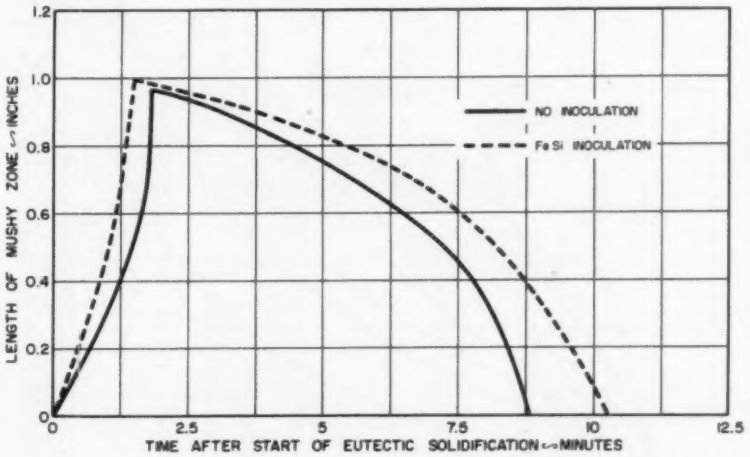


Fig. 14 — Length of mushy zone vs. time after start of eutectic solidification for uninoculated and inoculated irons.

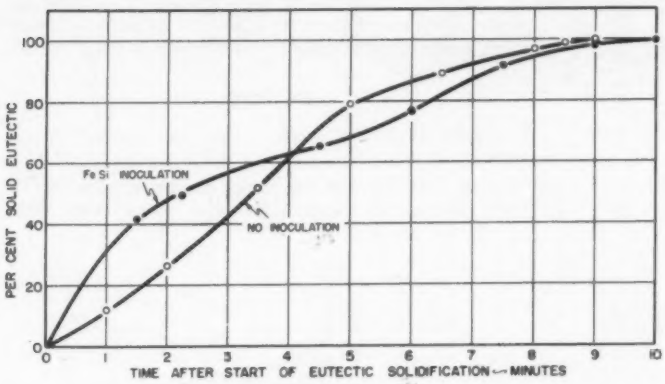


Fig. 15 — Per cent of solid eutectic at various times after start of eutectic solidification for uninoculated and inoculated irons.

In addition to a quantitative indication of the progress of solidification, this quenching experiment also provides a fairly precise estimation of the solidification rate at different depths in the casting during eutectic solidification. By using the formula in the Appendix, the area under each curve in Figs. 9 and 10, indicates the fraction of the casting that was solidified at the time of quenching. These data can be plotted as the per cent of the casting solidified versus the time after start of eutectic solidification for uninoculated and inoculated castings, as illustrated in Fig. 15.

The per cent solid eutectic is higher in inoculated castings than in uninoculated castings during the first stages of solidification, but the situation is reversed after about half of the eutectic has solidified. From this plot, the solidification rates of the casting during eutectic solidification can be computed for both uninoculated and inoculated irons, as shown in Fig. 16. It is apparent that the solidification rate of inoculated iron is initially higher than uninoculated iron, and that it decreases gradually as solidification progresses.

The solidification rate of uninoculated iron, on the other hand, is slow at the outset, gradually increases, attains a maximum and then decreases. These variations in the solidification rates of uninoculated and inoculated irons indicate changing rates of heat abstraction by the mold, and provide circumstantial evidence of the formation of air gap during the first stages of eutectic solidification of uninoculated castings.

The earlier formation of the solid skin, and less mushy type of solidification, that occurs in uninoculated irons assist in explaining the reduced mold wall movement in these irons compared to inoculated irons. The solid skin is better able to resist the metallostatic liquid force and graphitic expansion pressure during eutectic solidification. The less mushy type of solidification causes less entrapment of solidifying liquid, and permits better metal flow within the solidifying casting.

CONCLUSIONS

The eutectic solidification temperature range occurs at higher temperatures in inoculated compared to uninoculated 4.0 per cent carbon equivalent gray iron. The thermal gradients across the casting section are slightly shallower during the eutectic solidification of an inoculated compared to uninoculated gray iron.

Inoculation of gray iron delays the formation of an air gap at the mold-metal interface during solidification. Associated with this delay in gap formation is the small temperature difference between mold and metal at the interface, high eutectic freezing rate across the casting section during the early stages of solidification and delay in the formation of a complete solid skin in the casting.

The inoculation of gray iron results in an earlier start of eutectic solidification, a faster initial rate of solidification, a subsequently slower rate and a greater depth of the liquid-solid zone compared to uninoculated iron. The time during which eutectic solidification occurs is somewhat longer than for un-

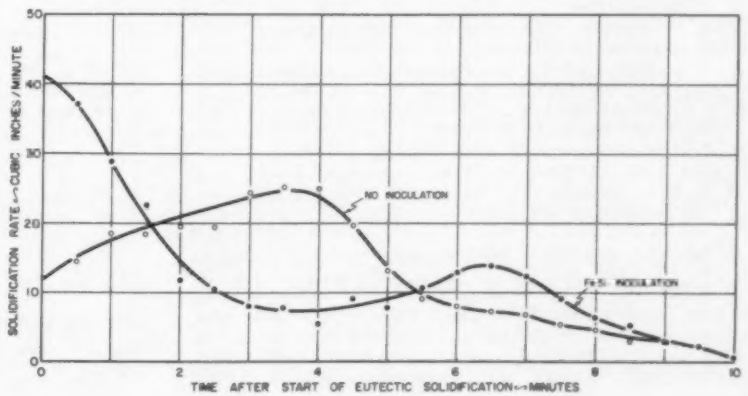


Fig. 16 — Solidification rates of uninoculated and inoculated irons at various times after start of eutectic solidification.

inoculated irons, but the total solidification times are similar for both irons.

These factors assist in explaining the greater mold wall movement that occurs in inoculated irons poured in green sand molds.

ACKNOWLEDGMENT

The assistance of Superior Foundry, Inc., Cleveland, in conducting the melting and pouring for all castings is gratefully acknowledged.

REFERENCES

1. H. D. Merchant and J. F. Wallace, "Inoculation Effect on Risering of Gray Iron," AFS TRANSACTIONS, *vol. 68* (1960).
2. K. P. Bunin and L. A. Dolinskaya, "On the Nature of Eutectic Graphite in Gray Iron," *Litoinoe Proizvodstvo, vol. 4*, p. 21 (1953); K. P. Bunin, Y. N. Malinochka and S. A. Federova, "Structure of Austenite-Graphite Eutectic," *Ibid, vol. 4*, p. 25 (1953).
3. H. Morrogh and W. Oldfield, "Solidification of Gray Cast Iron," *Iron and Steel, vol. 32*, no. 11-12 (Sept.-Oct. 1959).
4. A. G. Fuller, "Sinking under Bosses on Thin Plates — the Effect of Variations in Pouring Temperature," *B.C.I.R.A. Journal of Research and Development, vol. 7* (Oct. 1959).
5. I. C. H. Hughes, K. E. L. Nicholas, A. G. Fuller and T. J. Szajda, "Factors Influencing Soundness of Gray Iron Castings," AFS TRANSACTIONS, *vol. 67*, p. 336 (1959).
6. M. Ferry and J. Margerie, "Grain Size in Gray Iron," *Fonderie*, no. 108, p. 42 (Jan. 1955); no. 138 (July 1957).
7. M. Ferry and J. Margerie, "Causes and Effects of Grain Size in Pearlitic Gray Cast Iron," AFS TRANSACTIONS, *vol. 64*, p. 41 (1956).
8. H. Morrogh, "Problem of Grain Size in Cast Iron," *British Foundryman, vol. 51*, part II, p. 588 (Nov. 1958); Saertrykk av Stoperitidende, no. 6-7 (1956).
9. J. V. Dawson, "The Effect of Aluminum on the Inoculating Power of Ferro-Silicon and its Tendency to Give Pinholing," *B.C.I.R.A. Journal of Research and Development, vol. 7*, p. 2 (Aug. 1957).
10. N. C. McClure, A. U. Khan, D. D. McGrady and H. L. Womochel, "Inoculation of Gray Cast Iron," AFS TRANSACTIONS, *vol. 65*, p. 340 (1957).
11. A. G. Fuller, "Further Studies on Some Factors Influencing Sinking under Bosses on Thin Plates: The Rate of Eutectic Nucleation," *B.C.I.R.A. Journal of Research and Development, vol. 7*, p. 157 (Feb. 1958).
12. W. Oldfield, "The Solidification of Hypoeutectic Gray Cast Iron," *B.C.I.R.A. Journal of Research and Development, vol. 8*, no. 2, p. 177 (Mar. 1960).
13. A. Hultgren, Y. Lindblom and E. Rudberg, "Eutectic Solidification in Gray, White and Mottled Hypoeutectic Cast Irons," *Journal of Iron and Steel Institute, vol. 176* (1954).
14. H. Morrogh, "The Solidification of Cast Iron and the Interpretation of Results Obtained from Chilled Test Pieces," *British Foundryman, vol. 53*, part 5, p. 221 (May 1960).
15. J. H. Gittus and I. C. H. Hughes, "The Solidification of Castings in Relation to their Soundness," *B.C.I.R.A. Journal of Research and Development, vol. 5*, no. 10 (Feb. 1955).
16. R. A. Clark, "Inoculation of Gray Cast Iron," *Foundry*, p. 100 (May 1959).
17. H. W. Lownie, "Theories of Gray Iron Inoculation," AFS TRANSACTIONS, p. 836 (1946).
18. J. T. Eash, "Effect Inoculation on Solidification of Gray Cast Iron," AFS TRANSACTIONS, *vol. 49*, p. 887 (1941-42).
19. J. F. Wallace and E. B. Evans, "Risering of Gray Iron Castings," AFS TRANSACTIONS, *vol. 66*, p. 49 (1958).
20. J. F. Wallace and E. B. Evans, "Gating of Gray Iron Castings," AFS TRANSACTIONS, *vol. 65*, p. 49 (1957).
21. K. E. L. Nicholas, "The Influence of Mold Rigidity, Pouring Temperature and Metal Composition Upon the Soundness of Fed Nodular and Flake Graphite Iron Castings," *B.C.I.R.A. Journal of Research and Development, vol. 7*, no. 10, p. 605 (Feb. 1959).
22. H. Morrogh, "The Polishing of Cast Iron Micro-Specimens and the Metallography of Graphite Flakes," *Journal of Iron and Steel Institute, vol. 143*, p. 195P (1941).
23. J. G. Henzel, Jr. and J. Keverian, "Gap Formation in Permanent Mold Castings," AFS TRANSACTIONS, *vol. 68*, p. 373
24. W. Oldfield, "The Origin of Flake Graphite Formed During High Temperature Heat Treatment of White Cast Iron," *Journal of Research and Development, vol. 7, no. 15*, p. 844 (Dec. 1959).

APPENDIX

Consider a casting with a one in. radius that is quenched in water at a given time during solidification, and that data in the form of the graph in Fig. 17 is obtained for that particular time. This plot

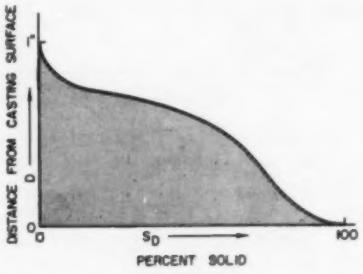


Fig. 17 — Solidification from center to surface of casting at a given time (schematic).

indicates the progress of solidification from the surface to center of the casting, and shows the per cent of the casting solidified at various distances from the surface of the casting. It is desired to estimate per cent of the whole casting solidified from this plot.

Assume a small circular strip dD in. thick at a distance D in. from the casting surface, as shown in Fig. 18:

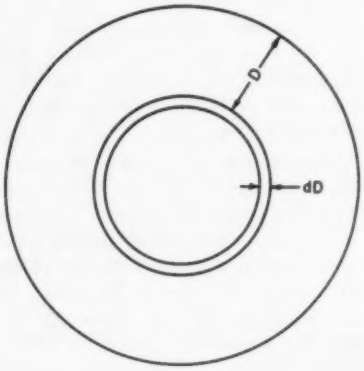


Fig. 18 — Transverse section of a cylindrical casting with one in. radius (schematic).

then,

$$\text{Area of the strip} = \pi(1-D)^2 - \pi[1-(D+\Delta D)]^2$$
$$= 2\pi\,\Delta D\,(1-D)$$

$\therefore$ Amount of solid in the strip
$= (\%$ solid in the strip$) \times$ (area of the strip)
$= S_D \cdot 2\pi \cdot \Delta D\,(1-D)$

$\therefore$ Amount solid in the whole casting at the instant of quenching is given by:

$$\%\ \text{Solid} = 2\pi \int_0^1 (1-D)\,S_D \cdot dD$$

This equation may be used with Fig. 17 to calculate the per cent of the whole casting that has solidified by graphical methods.

1961

Charles Edgar Hoyt Memorial Lecture

CAST METALS AND CAST SHAPES

by J. B. Caine

ABSTRACT

Evidence is presented that slight changes in shape and size by design can significantly increase load carrying ability by decreasing applied stress. The possible decrease in applied stress by design overshadows variations in strength of metals to such a degree as to make the classic mechanical properties of the metal of minor significance. Casting is the most efficient method of producing such shapes.

CASTING DESIGN

There are many aspects to casting design. Perhaps the one least appreciated, and perhaps the most important, has to do with the competitive position of the foundry industry. The industry must face one unpleasant fact. Many engineers, designers and users of castings are afraid of castings. The designer and engineer have been taught that castings make second grade parts. They have been taught that metal must be wrought for maximum physical properties. This teaching is not incorrect if based solely on classical tensile properties. The error involves improper evaluation of the significance of these properties. Improper evaluation has been compounded by the apathy of the foundry industry plus the human fear of the unknown. This combination has led to even ridiculous situations.

In one instance the engineers of one of the largest oil companies were so afraid of castings that they laid a pipe several hundred feet long, and sand bagged a cast steel valve they were testing to 600 psi water pressure. They were horrified when the writer stood on the valve during the test. Even if the valve had leaked, at worst the writer would have gotten his shoes wet. In no case would the casting have exploded.

Diametrically opposed to the experience of the previous paragraph, we have the belief of some designers that, in many instances, the strongest parts that can be made of a given metal at a given hardness are castings. This paper is an effort to answer these diametrically opposed viewpoints.

The proponents of castings in design have no supercast metal. In fact, they are willing to accept slightly lower classic mechanical properties in castings. The advantage of castings is derived from the ability of liquid metal to assume any shape, shapes that cannot be formed efficiently by any other forming process. This flexibility enables the design of shapes as castings that will uniformly distribute the load so that every ounce of metal is carrying its share. No part of the casting is overloaded, none underloaded. In short, stress concentration is at a minimum.

DESIGN FUNCTION

True, a study of applied stress is a function of design and seems alien to the foundryman. It behooves the foundryman to become familiar with at least one phase of design, that of junctions of sections and connecting members. Proper design of junctions and connecting members offers many advantages. Unfortunately, it seems as if this phase of design must be sold to the designer. Someone must do the selling. If streamlined cast design is accepted by the designers it opens up a vast field for castings. The opportunity to cast parts that have never been cast before. What is needed is effort on the part of the foundryman, for he alone has the incentive—more business. To be effective this effort must be backed up with knowledge. The following discussion may be considered an introduction to the basic concepts of casting design.

One phase of casting design can be summarized by the practical example of Fig. 1. The lever of Fig. 1a has been made as an alloy steel forging, specified to a yield strength of 100,000 psi yield strength. The inefficiency of the oval section of Fig. 1a as a

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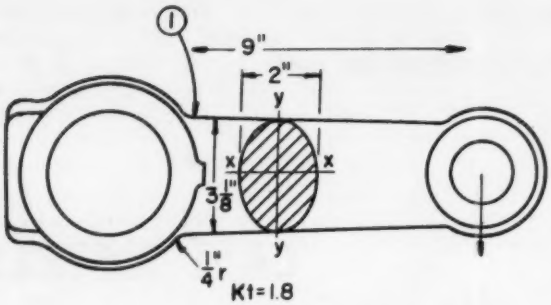

Fig. 1a — Oval section, area — 4.95 sq in. I_x — 2.9 in.^{4}, I_y — 1.2 in.^{4} S_x — 1.9 in.^{3}, S_y — 1.2 in.^{3} (1) A load of 21,000 lb about the *X* axis, and 13,400 lb about the *Y* axis, results in modulii of rupture of 100,000 psi in this area.

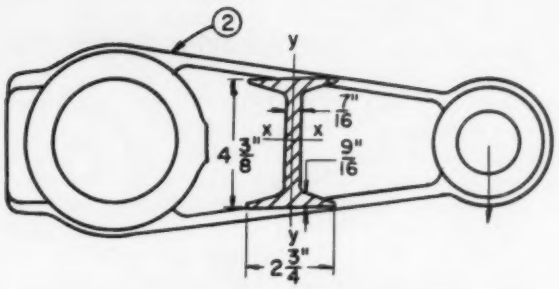

Fig. 1b — I-beam section, area — 4.55 sq in. I_x — 12.1 in.^{4}, I_y — 1.9 in.^{4} S_x — 5.5 in.^{3}, S_y — 1.4 in.^{3} (2) A load of 21,000 lb about the *X* axis results in a modulus of rupture of 34,000 psi. A load of 13,400 lb about the *Y* axis results in a modulus of rupture of 87,000 psi in this area.

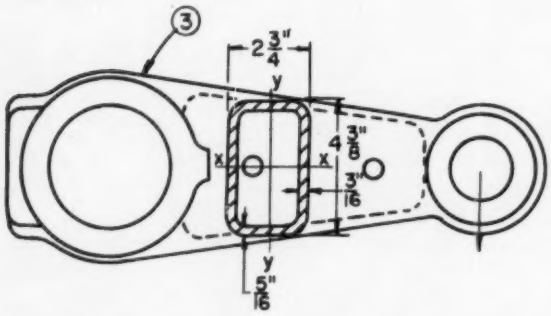

Fig. 1c — Cast tubular section, area — 4.6 sq in. I_x — 11.2 in.^{4}, I_y — 4.6 in.^{4} S_x — 5.1 in.^{3}, S_y — 3.4 in.^{3} (3) A load of 21,000 lb about the *X* axis results in a modulus of rupture of 37,000 psi. A load of 13,400 lb about the *Y* axis results in a modulus of rupture of 45,000 psi in this area.

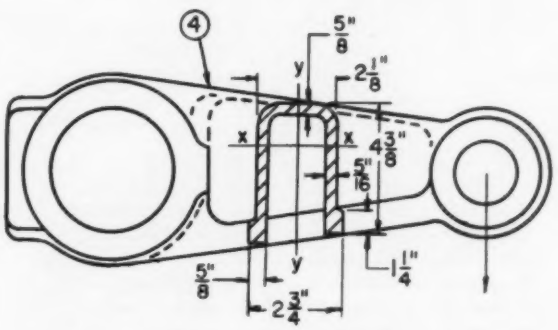

Fig. 1d — Cast *U* section, area — 4.6 sq in. I_x — 9.1 in.^{4}, I_y — 6.2 in.^{4} S_x — 4.2 in.^{3}, S_y 5.0 in.^{3} (4) A load of 21,000 lb about the *X* axis results in a modulus of rupture of 44,000 psi. A load of 13,400 lb about the *Y* axis results in a modulus of rupture of 27,000 psi in this area.

Fig. 1 — Relationship between shape and imposed stress. *t* equals section thickness.

load carrying member is self evident. Most of the metal is near the centerline, and is not carrying nearly its share of the load.

The connecting member of the lever of Fig. 1 can be either cast, or forged as an I-beam section, like Fig. 1b. The better metal distribution has decreased the imposed stress, as measured by modulus of rupture, for a given load in the direction of the arrow to a third of that of the oval section. The example shows that the modulus of rupture is decreased from 100,000 psi to 34,000 psi. This decrease in imposed load is exactly the same, as far as load carrying ability is concerned, as increasing the strength of the metal three times. If the lever is cast, this increase in load carrying ability can be obtained at practically no increase in cost. The more complex dies required to form the I-beam section can make the shape of Fig. 1b quite costly as a forging, especially if the quantities are small.

The imposed stresses just discussed, as well as those to be discussed later, are determined by the moment of inertia (I) and section modulus (S) about the *X* and *Y* axes (I_x, I_y, S_x, S_y) as given in Fig. 1.[1,2]

In many instances a part is subjected to loads in more than one direction and to twisting. The I-beam section of Fig. 1b, as well as most wrought sections, do not have the ability to resist loads in all directions. In the example of Figs. 1a and 1b the imposed stress caused by a load in the direction of the arrow (about the *X* axis) is decreased from 100,000 to 34,000 psi. The stress caused by a transverse load at right angles to the arrow and plane of the paper (about the *Y* axis) is only decreased from 100,000 to 87,000 psi. Therefore, the I-beam section is satisfactory if the load is only in one direction. It is unsatisfactory if there is major complex loading.

CASTING FLEXIBILITY

The flexibility of casting allows other shapes that decrease imposed stress when loaded in all directions. The tubular section of Fig. 1c is one such shape. All stresses as measured by modulus of rupture are now less than 45 per cent those of the oval section

of Fig. 1a. Two outstanding advantages of cast design are self evident.

1. The load carrying ability of the part when made of the same metal, at the same hardness and strength is more than doubled. A cheaper, more machinable, more foolproof metal can be used. In the example of Fig. 1, carbon steel, or perhaps pearlitic malleable, or ductile iron can be substituted for the liquid quenched and tempered alloy steel now used. The oval section of Fig. 1a requires a metal of 100,000 psi yield strength. The tubular section requires a metal with 37,000 to 45,000 psi yield strength under static loading depending on just how the load is applied.
2. The possible savings in alloy, heat treatment and especially machining is in excess of 20 per cent of the cost of the rough part.

The cost of the core required to make the tubular section must be charged against the above savings. If this core cost is excessive, or the core is objectionable for any other reason, the flexibility of casting allows many compromises. One compromise is the U-section of Fig. 1d. No core is required. The inspection problems of hollow sections are overcome. It is never possible to obtain quite as uniform resistance to complex loading with an open sided section as can be obtained with a tubular section, but casting can come close.

The imposed stresses with the same loads of 21,000 and 13,400 lb are now 44,000 and 27,000 psi. The load carrying ability of the U-section of Fig. 1d is still over double that of the oval section. The substitution of the cheaper, more machinable metals, as discussed previously, is still possible.

It cannot be emphasized too strongly that the variations in imposed stress just discussed have the same influence on load carrying ability in service as equal variations in the strength of the metal. Variations due to shape in Fig. 1 of over 100 per cent grossly over shadow commonly accepted variations in strengths of metals to the point of making discussions about a few thousand psi in yield and tensile strength mere quibbling.

DUCTILITY

A similar situation exists regarding so called ductility. If the 8 in. tension face of the connecting members of Fig. 1 elongates uniformly due to overloading even 4 per cent the lever as a whole will bend over 2 inches. Even a small fraction of such deformation will render any mechanism, or structure, inoperative due to misalignment. Under these conditions any discussion of tensile elongation over just one, or 2 per cent has no more meaning than a discussion of how many angels can dance on a head of a pin.

Tensile elongation only has meaning under conditions of stress concentration. If all deformation is concentrated in a small localized area, as is possible in the ¼-in. radius fillet of Fig. 1a, appreciable local deformation is necessary. But, the cast designs of Figs. 1c and 1d have no radius of any size. The connecting member blends into the hub at the point of maximum stress. It can be said without exaggeration that design by the elimination of points of stress concentration, has made discussion of differences in tensile ductility above just a few per cent as meaningless as quibbling over a few thousand psi tensile and yield strength.

For that matter the whole preceeding discussion has little meaning in any type of operating mechanism. The lever of Fig. 1 moves and is made of a ductile metal. Under these conditions, failure for most any reason, will be in fatigue. Now, even the old cry for maximum tensile properties for "insurance" has no meaning. Design and evaluation based on classic tensile properties is now dangerous. It has been and still is the cause of serious service failures.

The values of modulus of rupture in Fig. 1 are, in the metallurgist's language, maximum fiber stress. If a part is statically loaded transversely so that the modulus of rupture equals the tensile strength, it will not break. For that matter, it will show little permanent deformation. Stress decreases rapidly beneath the surface, as a straight line function, to zero at the neutral axis. Therefore, the highly stressed metal at the surface is supported by that beneath the surface. The average stress in parts similar to the lever of Fig. 1 is only half the modulus of rupture, or maximum fiber stress.

It cannot be emphasized too strongly that the principles of the preceeding paragraph do not apply in fatigue loading. The metal beneath the surface no longer supports the surface. If the fatigue strength of the surface metal is exceeded, a crack will start. This sharp crack causes stress concentration to such a degree that it overshadows the lower stress level beneath the surface and the crack progresses to failure.

FATIGUE FAILURE

The lever of Fig. 1a will surely withstand the loads given in Fig. 1, if they are applied statically. If the same loads are applied intermittently so that fatigue becomes operative, the lever will surely fail. Failure is a matter of load applications and time. Fatigue failure is accentuated by stress concentration imposed by the ¼-in. radius fillet of Fig. 1a. This fillet at the highly stressed junction of sections of Fig. 1a imposes a stress concentration factor of about 1.8.[3,4] This means that the maximum fiber stress is increased from 100,000 to 180,000 psi at this point. This maximum fiber stress is much above the fatigue strength of even the alloy steel.

The streamlined junctions of Figs. 1c and 1d impose little, or no, stress concentration as the connecting members are blended into the hub, or boss. Stress concentration approaches 1.0. Therefore, the 37,000 to 44,000 psi maximum fiber stresses of Figs. 1c and 1d are not increased. These imposed stresses are above the fatigue strength for infinite life of carbon steel castings with cast surfaces, but to a much lesser degree than for the alloy steel forging of

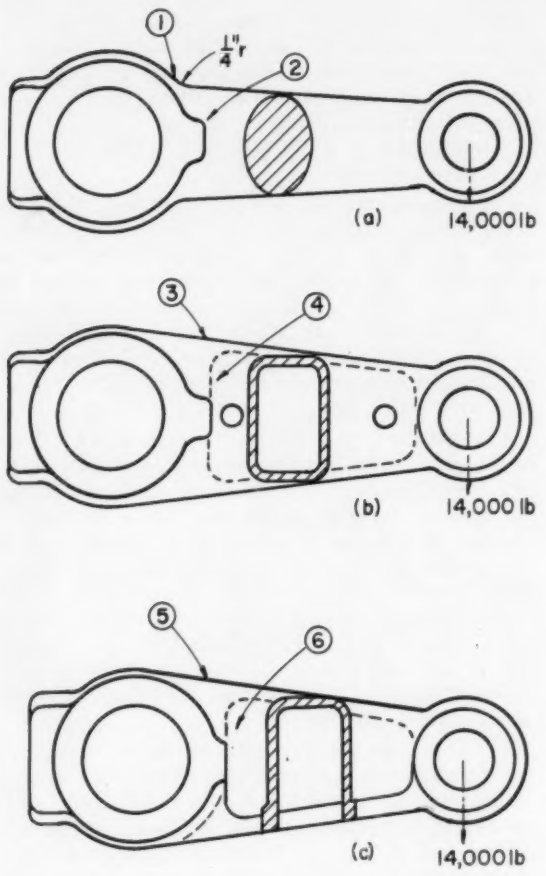

Fig. 2 — Relationship between shape, imposed stress, yield and fatigue strength. *(a)* — (1) Maximum fiber stress (modulus of rupture) due to 14,000 lb load — 66,000 psi. Stress concentration factor 1.8 = 118,000 psi. Fatigue strength of metal — 38,000 psi. (2) Average stress due to 14,000 lb load — 33,000 psi. Yield strength of metal 100,000 psi. *(b)* — (3) Maximum fiber stress ((modulus of rupture) due to 14,000 lb load — 25,000 psi. No stress concentration. Fatigue strength of metal — 26,000 psi. (4) Average stress due to 14,000 lb load — 15,000 psi. Yield strength of metal 45,000 psi. *(c)* — (5) Maximum fiber stress (modulus of rupture) due to 14,000 lb load — 29,000 psi. No stress concentration. Fatigue strength of metal — 26,000 psi. (6) Average stress due to 14,000 lb load — 14,500 psi. Yield strength of metal — 45,000 psi.

Fig. 1a. Instead of a difference in imposed stress in the order of 2, as discussed previously for static loading, the difference due to design is in the order of 4 to 5 times for fatigue loading. Again, this difference in imposed stress is the same as an increase in the strength of the metal.

It is interesting to compare the actual loads and stresses that would be applied by design using a conservative factor of safety of 3 based on yield strength. The maximum stress allowable for the 100,000 psi yield strength of steel of Fig. 2a would be 33,000 psi. A load in the direction of the arrow in Fig. 2 of 14,000 lb would impose an average stress of 33,000 psi in the junction of the connecting member and large boss. This would be considered conservative design.

Consider now what happens under fatigue loading. The maximum fiber stress at the surface is now the controlling stress, not the average stress. The 14,000 lb load imposes a maximum fiber stress of 66,000 psi. Stress concentration at the ¼-in. radius fillet may increase this stress by a factor of 1.8 to 118,000 psi. The fatigue strength of forged steel with a forged, unmachined surface is about 30 per cent of the tensile strength of 125,000 psi, or only 38,000 psi. The fatigue strength is exceeded by a factor of 3. The conservative static design of the preceeding paragraph is now grossly underdesigned for maximum service. The lever will fail after a few hundred thousand load applications of 14,000 lb.

MINIMUM STRESS CONCENTRATION

Consider now the streamlined cast designs of Figs. 2b and 2c when stress concentration is at a minimum. The same static load of 14,000 lb will impose an average stress of 15,000 psi in the tubular section of Fig. 2b. This is well below a yield strength of 45,000 psi for carbon steel, pearlitic malleable and ductile iron and the factor of safety of 3 still holds. The maximum fiber stress in fatigue is 25,000 psi, and this value need not be increased because of stress concentration. A normalized carbon steel can be easily produced meeting 80,000 psi tensile strength, 45,000 psi yield strength.

The fatigue strength of cast steel with a cast surface is about 33 per cent of the tensile strength,[5] or 26,000 psi. The maximum fiber stress of the streamlined cast design of Fig. 2b is below the fatigue strength. The same stress of the lever of Fig. 2a is 3 times the fatigue strength with the same load. The cast lever of Fig. 2b will perform indefinitely under fatigue loading, whereas the forged lever will eventually fail. Failure will depend on how often the maximum load is applied during its service life. The preceding is true even though the cast lever is made of a cheaper and theoretically weaker metal.

The same difference in applied stress, the same increase in true service strength, or service life, is shown by the cast lever of Fig. 2c. The levers of Figs. 2b and 2c are almost identical as far as load carrying

ability is concerned. Their chief differences have to do with possible economy, ease of production and inspection.

A good question at this time is if the standard design of Fig. 2a is so grossly underdesigned in fatigue, why are there not more fatigue failures. There are a number of good answers to this question. Unfortunately, all are hard to pin down to exact data. The first answer must be that there are a lot of fatigue failures, more than most people realize. Most occur after months, or years of service, and no one knows about them except those immediately concerned.

Complaints are registered with a second group. The complaints go through channels until it all finally boils down to whose fault it is. Almost invariably a tension test bar is taken from the offending member. If the tensile properties do not dot every *i* and cross every *t* of the specification the metal is at fault. Every one is satisfied—except the metallurgist. It seems to make no difference if the failure exhibits every indication of failure except failure in tension. Everyone is still satisfied—except the metallurgist.

STRESS VS. LOAD

However, the vast majority of parts do not fail. Although not proved, it is the writer's opinion that only a few operating mechanisms are operated at their full output for more than a small fraction of their useful life. The relation between stress and number of load applications for fatigue failure is logarithmic. Although the lever of Fig. 2a will withstand a load of 14,000 lb for only several hundred thousand applications, it will withstand a load of 10,000 lb indefinitely. The chances are it will be loaded most of its useful life at 10,000 lb, or less. The 14,000 lb load will only be applied occasionally.

This state of affairs does not mean that decreasing imposed stress by cast design is not significant. It is significant in either allowing higher loads with no increase in cost, or weight, or to decrease cost with the same load.

Admitted, Figs. 1 and 2 may be extreme examples. It is of interest to go to the other extreme and see what just a small change of ¼-in. in one dimension of a load carrying member will do. Figure 3 shows three cast sections, differing only by an increase of ¼-in. in the *H* dimension. Such a minor change can usually be made in any part without exceeding the overall dimensions, or influencing its performance. Such a change is simple with castings. Perhaps the reason such changes are not considered by the designer is that standardization mandatory with other forming processes makes such small changes impractical, or impossible.

The ¼-in. increase of the *H* dimension of the three cast sections of Fig. 3 decreases the major imposed transverse stress in bending 15 to 39 per cent. This causes a decrease in imposed stress at a 45,000 psi yield strength of carbon steel, ductile and malleable iron of 6800 to 17,600 psi.

Consider now the relation of this reduction in applied stress to its twin, tensile and yield strengths.

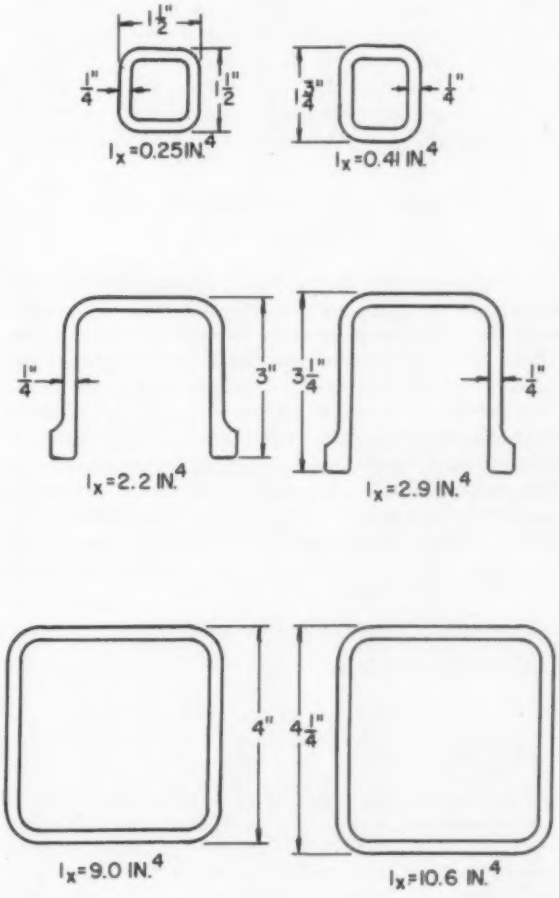

Fig. 3 — Relationship between size and imposed stress. *Top* — Imposed transverse stress of any magnitude decreased 39 per cent. *Left* — r = 0.48 in. *Right* — r = 0.60 in. Imposed compressive stress (buckling) of any magnitude decreased 20 per cent. *Center* — Imposed stress of any magnitude decreased 24 per cent. *Left* — r = 0.92 in. *Right* — r = 1.02 in. Imposed compressive stress (buckling) of any magnitude decreased 10 per cent. *Bottom* — Imposed transverse stress of any magnitude decreased 15 per cent. *Left* — r = 1.6 in. *Right* — r = 1.7 in. Imposed compressive stress (buckling) of any magnitude decreased 6 per cent.

A variation of 5000 psi in tensile and yield strengths is considered a major change—major to the point of warranting a separate grade in many metal specifications. A design change of less than ¼-in. is therefore equal to a separate grade in metal specification.

COMPRESSIVE LOADING

Compression strength of the members of Fig. 3 is increased from 6 to 20 per cent by the increase in resistance to buckling under compressive loading. This increase is in the same order of magnitude as the increase in transverse strength in bending just discussed.

Torsional strength (resistance to torsional loads) is increased, but to a lesser degree than for transverse and compressive loading. A decrease in torsional applied stress of 3 to 17 per cent is due to the ¼-in. increase of Fig. 3. However, this is still a major increase in service strength when translated into lb/sq in.

Perhaps the difference of 2 to 5 times in load carrying ability of the levers of Figs. 1 and 2 may seem extreme. Recent information indicates that difference in the order of 5 in resistance to fatigue loading due to slight changes in shape may be too conservative. The crux of the fatigue discussion has to do with stress concentration. It was estimated that stress concentration due to the ¼-in. radius fillet of the lever of Fig. 2a multiplied the overall stress by a factor of 1.8. The important point is if actual fatigue strength, or fatigue life, is decreased by a comparable factor.

STRESS CONCENTRATION AND FATIGUE LIFE

Nara, Wright and Briggs[6] have recently reported on stress concentration and fatigue life of *L* junctions, with the fillet in tension, as is the fillet of Fig. 2a. Those junctions pertinent to this discussion are shown in Fig. 4. The results are startling to say the least. The load used in these tests was quite high, above the yield strength of the steels, about 50,000 psi. An increase in fillet radius from ¼-in. to ⅝-in., as in Figs. 4a and 4b (all other factors remaining constant), increased the average* fatigue life, the resistance to fatigue failure, by a factor of almost 7. The stress concentration factor of the ¼-in. radius fillet of Fig. 2a may be closer to 7 than 1.8.

If a slight change in design is incorporated along with the larger fillet the increase in average fatigue life is almost unbelieveable, in the order of 22 times. The reason for this second and spectacular increase seems to be due to a slight change in stress pattern. The single point of high stress of Figs. 4a and 4b changes to two separate points when the corner is reinforced as in Fig. 4c.

However, simply changing the number of points of high stress does not automatically increase fatigue life, as shown by the design of Fig. 4d. The difference in fatigue life between Figs. 4c and 4d is not due to the forming processes, welding and casting. Nara, Wright and Briggs machined the fillets of the corners of Figs. 4c and 4d to the same radius. Fatigue lives were then essentially the same. The great difference in fatigue life must be due to slight differences in shape. The points of high stress of Fig. 4d coincide with rather abrupt changes in section that are themselves stress raisers.

The data of Fig. 4 and the reference[5] must be compared with accepted handbook data, that cast steel shows 10 to 20 per cent lower fatigue strength than wrought steel when the wrought steel is tested in the direction of hot work. The handbook data are based on small, polished specimens whose shape and surface are never approached in actual working parts. Which set of data is the most significant? The reader must judge for himself.

LOAD CARRYING ABILITY

Figure 4 again emphasizes the theme of this discussion. What are now considered minor changes in shape and size have great, even spectacular influences on actual load carrying ability. These seemingly minor changes in shape and size are influential to the extent of making classic mechanical properties of little significance. The advantage of castings is their ability to form the proper shapes efficiently. For example, how can the corner of Fig. 4c be formed efficiently other than by casting.

The importance of Nara, Wright and Briggs's work cannot be overemphasized. The information is basic. *L* junctions are incorporated in practically all designs. The data of Fig. 4 should therefore be applicable to all design. The only question is if the fillet radius is in tension. Even more basic is the concept of reinforcing points of high stress to disperse stress concentration. This concept is applicable not only to *L* junctions, but to many other shapes.

Just a little stress analysis work will determine just what increase in section modulus is required to more uniformly distribute the stress in areas of high stress. Stress analysis also can and should be used to apply the fundamentals discussed in this paper to the actual part. These fundamentals indicate the possible best shapes to be used to build the actual part. When these shapes are joined to make any but the simplest working part the stress pattern becomes so complicated that theoretical analysis becomes either impractical, or impossible.

Perhaps the first design will be satisfactory. Perhaps unexpected areas of high stress are present.

*Average values for fatigue life have been used in Fig. 4 for comparison rather than minimum values because of the possibility of defects being the major factor determining the minimum values. The specimens were tested as received, no selection was made. Defects were found in some junctions by radiographic and magnetic particle testing. It makes little difference in the comparison if minimum, or average values are used. The variation in minimum values was even greater than for the average values given. There was no correlation between defects and fatigue life. Junction 4a with the lowest fatigue life showed the fewest defects.

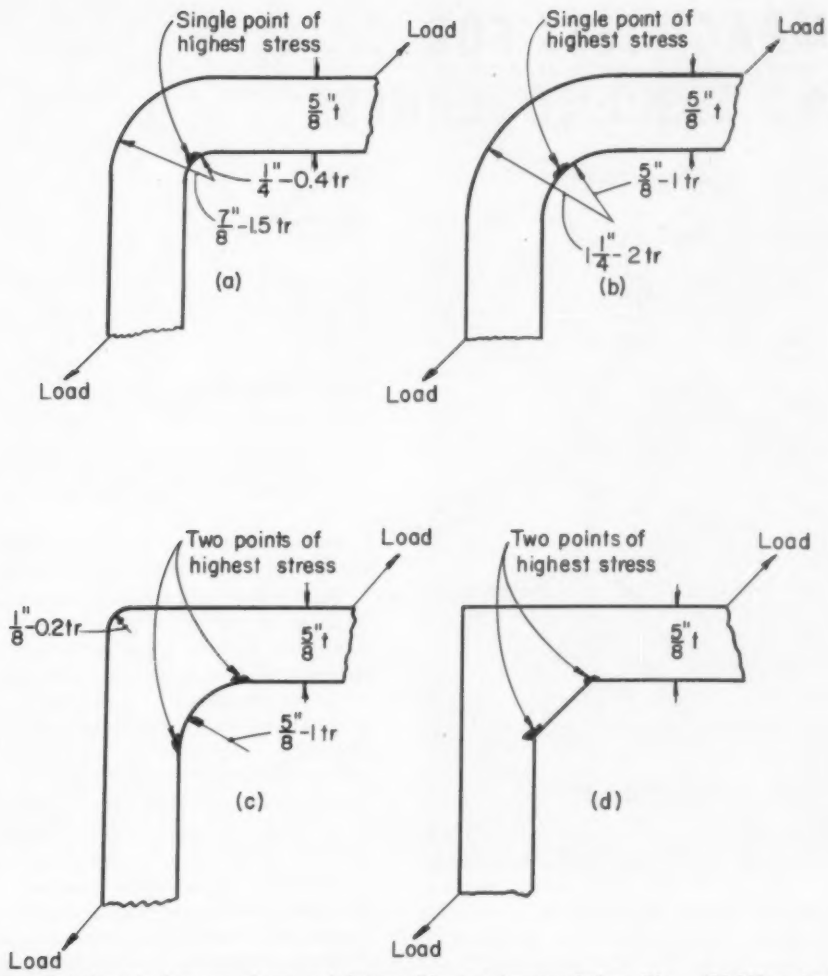

Fig. 4 — Relationship between shape and fatigue life. (a) Average fatigue life — 270,000 cycles of 1170 lb load. Cast junction. (b) Average fatigue life of 1,850,000 cycles of 1170 lb load. Cast junction. (c) Average fatigue life of 5,900,000 cycles of 1170 lb load. Cast junction. (d) Average fatigue life 601,000 cycles of 1170 lb. load. Machine welded junction stress relieved.

Stress analysis using relatively simple brittle lacquer techniques will go far as the final check. Brittle lacquer will give the overall picture of stress distribution. The more complicated strain gage techniques are necessary only if accurate quantitative data are needed. There are a number of foundries with stress analysis departments qualified to do this work.

CONCLUSION

The foundry industry as a whole must be familiar with this work, not just a few foundries. Casting is about the only way the slight changes in shape and size discussed throughout this paper can be efficiently incorporated into a metal part. W. J. Grede in his Hoyt Memorial Lecture last year stressed some worrisome data. He showed the foundry industry to be moribund. True, it is not dying, but it is not growing. The use of ferrous castings, the largest segment of the foundry industry, is not keeping pace with population growth. Casting design offers the hope of reversing this trend—to make castings lead the parade rather than take a back seat to newer, better promoted forming processes.

The promotion of just one simple point, the use of fillet radii equal, or greater than the section thickness will do more to increase service strength, will do more to promote the use of castings, than any half dozen highly advertised "revolutionary" foundry methods.

REFERENCES

1. J. B. Caine, "What Foundrymen Should Know About Casting Design," *Foundry* (Jan. 1959).
2. T. J. Pisani, *Essentials of Strength of Materials*, John Wiley and Sons Co., New York.
3. J. B. Caine, "Dynamic Loading, Its Effect on Casting Design," *Foundry*, (April, May 1959).
4. R. E. Peterson, *Stress Concentration Design Factors*, John Wiley and Sons Co., New York (1953).
5. Evans, Egbert and Briggs, "Fatigue Properties of Comparable Cast and Wrought Steels," *A.S.T.M. Procedures, vol. 56*, p. 979 (1956).
6. Nara, Wright and Briggs, "Studies of the Design of Steel Castings and Steel Weldments as Related to Their Methods of Manufacture," *A.S.M.E. preprint 60-SA2* (1960).

JOLT IMPACT TEST FOR MOLDING SAND TOUGHNESS

by H. W. Dietert and T. E. Barlow

ABSTRACT

A study of the toughness of molding sand was made as measured by jolt impact tester (AFS nonstandard test), termed green core impact test, pages 167, 168, FOUNDRY SAND HANDBOOK, sixth edition (1952). The length of the overhang for molding sand was increased from 7/16-in. to 9/16-in. to reduce the number of jolts to conservative numbers.

The relationship between various molding sand properties and jolt toughness of sand are shown. These relationships can be used to start a control program on sand toughness which will lead to better rammed molds.

A study of mold quality as affected by sand toughness will prove to be productive research.

INTRODUCTION

Molding sand as used in the foundry must be both a mobile and a static material. When the sand is rammed around the pattern the sand must possess a mobile property, and while the metal is solidifying in the mold the sand must have a static property to produce castings that are precise in dimensions.

The mobile property of a sand has been termed by many as the rammability or moldability of a sand. The static property which imparts load carrying property, may be measured by creep deformation.

Sand initially is in a static phase, but as soon as force is applied in ramming, a movement or flow occurs which ruptures the bond, allowing for re-arrangement of the sand grains.

When force, that is pressure, is applied and movement occurs during ramming then one accomplishes work.

$$\text{Force} \times \text{Distance} = \text{Work}$$

The work required to place the sand grains firmly and uniformly around the pattern will dictate to a great extent the ramming energy required to obtain a given mold hardness and absence of false mold wall voids. The toughness of the sand will affect the amount of work that has to be expended on the sand.

The factor of sand toughness of a sand becomes of prime importance in all forms of ramming. Sand toughness of a particular sand should be held at a predetermined level and controlled within reasonable limits of the chosen value to insure the production of well rammed molds.

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SAND TOUGHNESS MEASUREMENT

Many methods of measuring sand toughness are in use today. Three methods will be briefly described.

One of the older methods of measuring sand toughness is by using a compressive strength machine equipped with a recorder to draw the stress-strain diagram of a sand. Another procedure for this method is to simply equip a compressive strength machine with an ultimate green deformation indicator. The indicator mechanism is preferably equipped with a center fulcrum linkage which stops the indicator reading when the rate of collapse first exceeds the rate of loading. This is a precise method, but it requires careful operation since one is measuring to 0.001 in.

When a stress-strain diagram is employed, the problem of locating the point on the graph where strain first exceeds the stress on some sands is open to human judgment. With either method, the stress (lb/sq in. compressive strength) is multiplied by the strain (deformation) and multiplied by 1000 yielding a product that expresses the sand toughness; a factor that influences the work required in ramming.

A sand toughness measurement method that is in use in England[1] is termed the shatter test. In the shatter test, an AFS sand specimen is dropped 6 ft on a steel anvil. In this test, the force is secured in the form of kinetic energy from the drop, causing a movement to rupture the specimen. The fractured sand specimen pieces are caught on a screen with ½-in. mesh. The weight of sand specimen of sufficient size to be retained on the ½-in. mesh is expressed in percentage of the original specimen weight as the shatter index, a toughness measurement.

Jolt Toughness Method

The third method of measuring sand toughness is a new development in applying it to molding sand. This method is termed jolt toughness. The method employs the principle of the AFS Core Impact Test.[2] The only two changes made are in the size of the overhang and specimen holder. The length of overhang when the test is used for molding sand is increased to $^{9}/_{16}$-in. from $^{7}/_{16}$-in. as used on core sands. The molding sand specimen is solidly held in the anvil holder by means of a spring loaded strap.

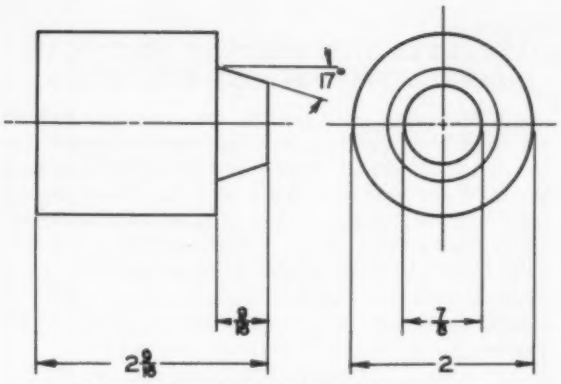

Fig. 1 — Dimensional drawing of the test specimen used to determine the jolt toughness of molding sands.

Fig. 2 — Jolt toughness tester used to measure the toughness of sands in this investigation.

The molding sand sample dimensions are shown in Fig. 1. The sand specimen is formed in the conventional AFS manner, with the exception that a ring-shaped pattern is placed in the specimen tube pedestal assembly prior to placing the sand in the tube. The ramming force of the AFS sand rammer causes the sand to flow into the restricted overhang section. As the work required to cause the sand to flow varies, the ramming perfection of the overhang restricted section is affected.

The rammed sand specimen is strapped to a curved-shaped anvil of the jolt impact tester, as illustrated in Fig. 2. The motor drive causes the anvil to repeatedly rise and drop a distance of 0.2 in. The number of jolts required to cause the overhang section to drop off the sand specimen is read from a counter and recorded as the jolt toughness. The authors are of the opinion that this new test, which measures the sand toughness property on a restricted portion of a rammed specimen, offers a test method for studying the toughness property of molding sands.

The relationship that exists between the shatter test and the jolt impact test for fireclay and Western bentonite bonded sands is illustrated in the graphs of Fig. 3.

When the shatter index exceeds 70 per cent for the fireclay bonded sand, the shatter test has a slow rise as toughness increases. This same condition exists for the Western bentonite bonded sand when the shatter index exceeds 90. Thus, the sensitivity of the shatter test evaluation of sand toughness on the tough sand diminishes, while the jolt impact test retains its sensitivity over a wider range of toughness.

Sand Toughness Values

Sand toughness values, as obtained by multiplying the compressive strength by ultimate green deformation, are related to jolt toughness values, as shown by graphs in Fig. 4. The relationship for 80 per cent Southern bentonite, 8.0 per cent Western bentonite and 15 per cent fireclay bonded sands, between jolt toughness and compression deformation sand toughness, indicates that both the strength multiplied by deformation and jolt test methods measure the same property when the sand is rammed to different hardnesses. The jolt impact test, however, is the simpler test to perform. The sands used for the tests in Fig. 4 were all tempered with sufficient water to yield an ultimate green deformation of 0.018 in.

Holding the ultimate green deformation constant yielded a temper point where sufficient moisture was present to soften or plasticize the bond to the same degree. Ultimate green deformation is a useful tool for describing and controlling a degree of temper.

The stress-strain (strength × deformation) sand toughness correlates well with the shatter index, Fig. 5. The rate of shatter index decreases, indicating a reduced sensitivity for the tough sands.

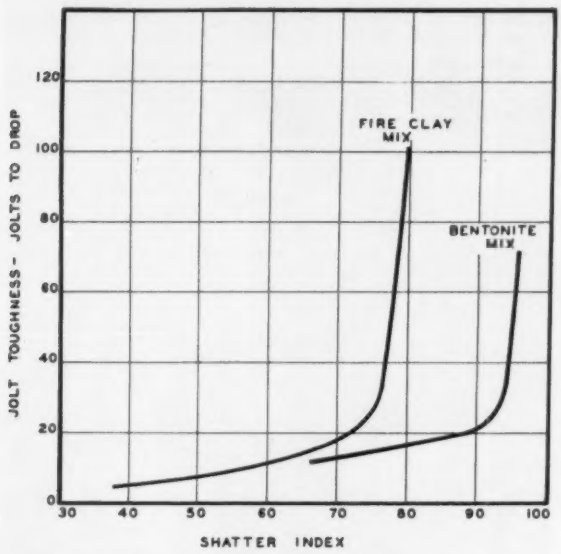

Fig. 3 — The relationship between shatter test values and jolt toughness values.

GRAIN FINENESS EFFECT ON JOLT TOUGHNESS

In the interest of simplification, the grain fineness of sand will be described by using the AFS Grain fineness number. Bonding sand mixes consisting of sand grains of different AFS Grain fineness numbers with 6 per cent Western bentonite and tempered to 0.018 in. ultimate green deformation yielded sands having little differences in jolt toughness, as illustrated in Fig. 6. For all practical purposes, jolt toughness is not affected by a change in grain size.

PERCENTAGE OF WESTERN BENTONITE BOND EFFECT ON JOLT TOUGHNESS

An interesting and practical sand condition may be obtained when the percentage of Western bentonite is increased and the ultimate green deformation is held constant, for example, 0.018 in. The bond in the sand is not fully wetted but only sufficiently wetted to yield a constant ultimate deformation, i.e., a constant total plasticity. Under such control, the green strength increases substantially at a rate which is similar to the rate of increase of jolt toughness, as the percentage of Western bentonite increases.

An increase of Western bentonite increases the jolt toughness. The amount of jolt toughness increase will depend on the degree of temper, when other conditions are held constant. In the case of the sand mixes described for Fig. 7, the degree of temper was held in check by tempering to constant ultimate green deformation. Thus, limiting the increase in jolt toughness making for relatively easy ramming of the highly bonded sands.

MOISTURE AND ADDITIVES EFFECT ON JOLT TOUGHNESS

Water may be termed an additive, and under this premise sand mixes containing additives such as 2 per cent wood flour, 15 per cent silica flour, were mixed with different amounts of water additions, the base sand being a Michigan City Lake Sand of 58 AFS Grain fineness number. The effect of these additives on the jolt toughness is illustrated in Fig. 8.

Noting first the jolt toughness of a 6.0 per cent Western bentonite bonded sand with water as the only additive, it becomes apparent that moisture addi-

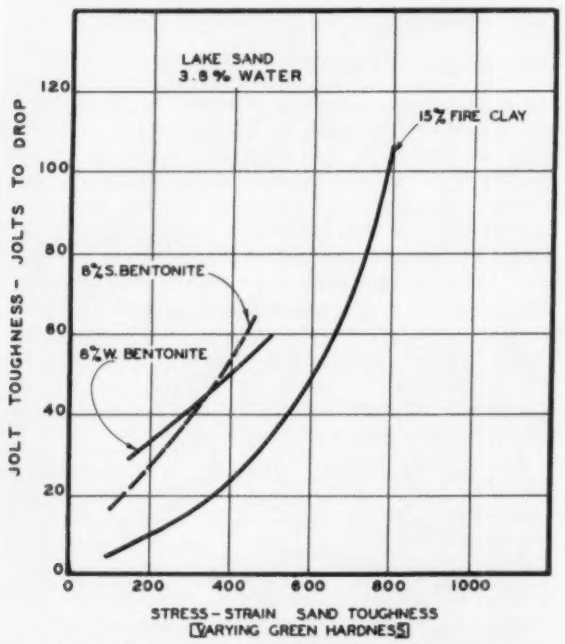

Fig. 4 — The relationship between the stress-strain sand toughness and jolt toughness.

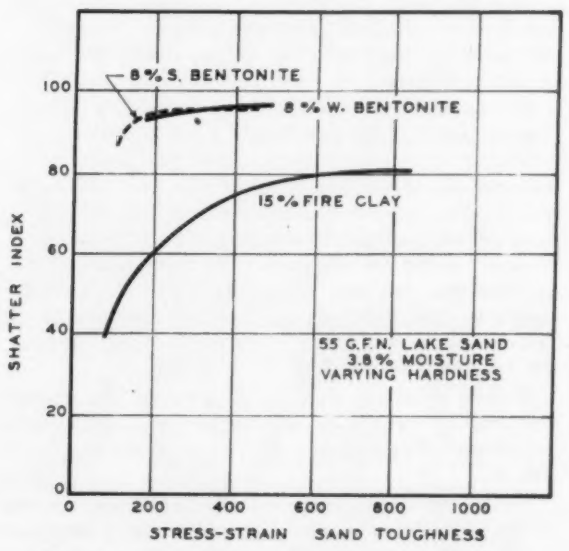

Fig. 5 — The relationship between shatter index and stress-strain sand toughness.

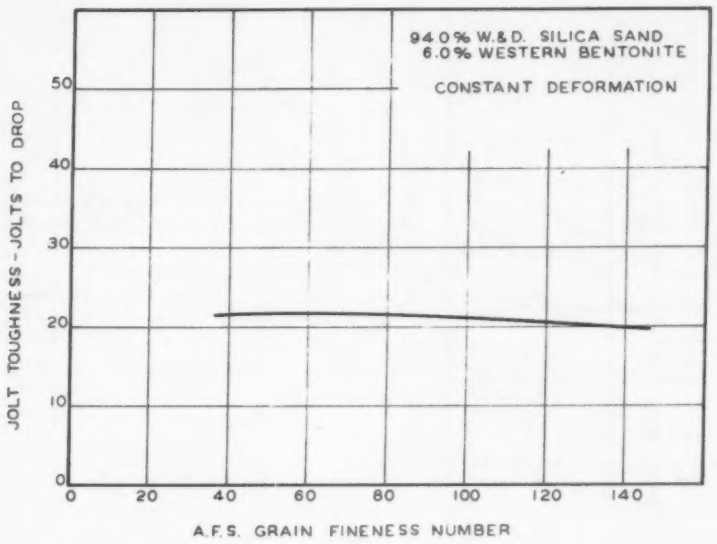

Fig. 6 — The jolt toughness of a bentonite bonded sand is not greatly affected by a change in the grain fineness up to 140 mesh grain.

tions below temper point of 0.018 in. ultimate green deformation (U.G.D.) influences the jolt toughness greatly. The 0.018 in. U.G.D. points are marked by X on the graphs, Fig. 8. A slight drop in jolt toughness is experienced above 2.5 per cent moisture.

When 2 per cent wood flour is added to the previous mix the jolt toughness is reduced for the particular cellulose material used, and the sand is tempered below the 0.018 in. U.G.D. point. As moisture is increased above the 0.018 in. U.G.D. point, the jolt toughness is increased above the jolt toughness of a straight bentonite bonded sand. A sand of low toughness can be produced by working the sand on the dry side of temper. The addition of 15 per cent silica flour produces a sand of low jolt toughness.

Continuing the study of the effect of additives on jolt toughness, by referring to Fig. 9, it may be noted that an addition of 5.0 per cent sea coal increases the jolt toughness. The addition of 2 per cent cereal increases the jolt toughness rapidly as moisture is increased. Ample moisture must be present, however, to plasticize the cereal to make it effective. Running moisture low may actually cause the cereal-bentonite bonded sand to possess a low jolt toughness. Additives materially affect jolt toughness of sands.

MOLD HARDNESS AFFECTS THE JOLT TOUGHNESS

An increase of mold hardness will increase the strength of a sand while it will not alter the ultimate green deformation value. An increase of mold hardness, particularly so, above 75 green hardness, will markedly increase the jolt toughness whether the

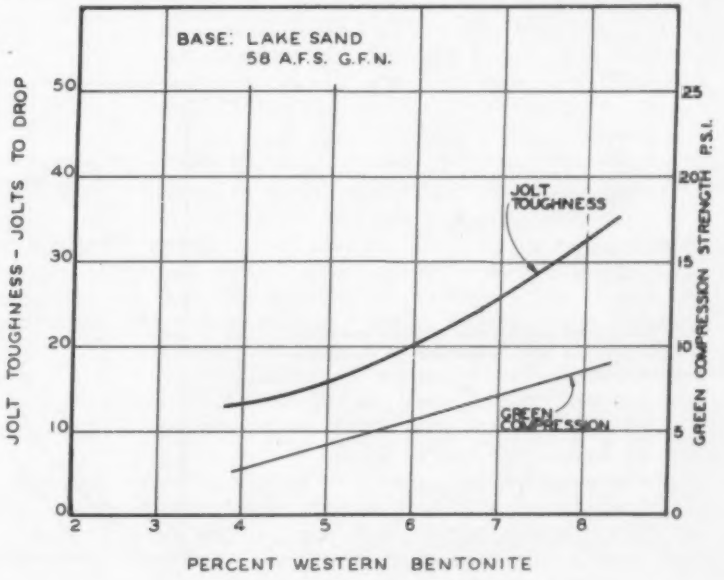

Fig. 7 — An increase of Western bentonite bond in a sand increases the jolt toughness.

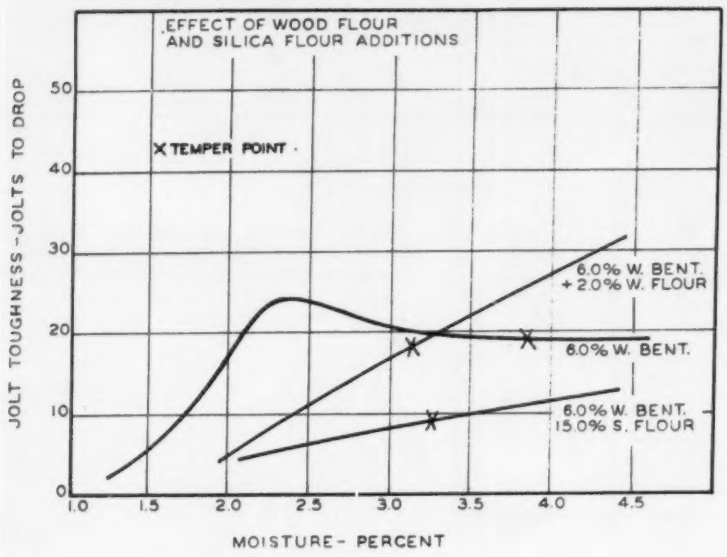

Fig. 8 — Moisture content materially changes the jolt toughness of bentonite sand with and without additives.

sand is bonded with Western bentonite, Southern bentonite or fireclay (Fig. 10).

The bentonite bonded sands produce a greater jolt toughness more readily than some fireclay bonded sands. However, they also produce a higher mold hardness for a given ramming energy. Some fireclays contain upward of 40 per cent inert fine material that retards jolt toughness, similar in action as silica flour retarding jolt toughness.

INFLUENCE OF JOLT TOUGHNESS IN RAMMING OF MOLDS

Many of the casting losses are produced by the presence on the mold face of false void spaces that are not comparable with the grain fineness. False void spaces make for penetration and rough finish. A false void space is secured when adjacent sand grains do not pack together. They leave a void space that is not comparable to the fineness of the sand grains.

A flowability indicator attached to the top of a sand rammer may be used to measure the degree of false void presence. The greater the indicator flowability percentage the smaller the false void spaces for a given grain fineness. This correlation holds true for many sands.

The comparison between the jolt toughness and the above mentioned flowability percentage is illustrated in Fig. 11. The graph in Fig. 11 shows that as the jolt toughness decreases, flowability increases. Stated in another manner, an excess of jolt toughness hinders the ramming of a good mold face with a minimum of false void spaces. The percentage of moisture used in the sand mixes for Fig. 11 are marked on the graph.

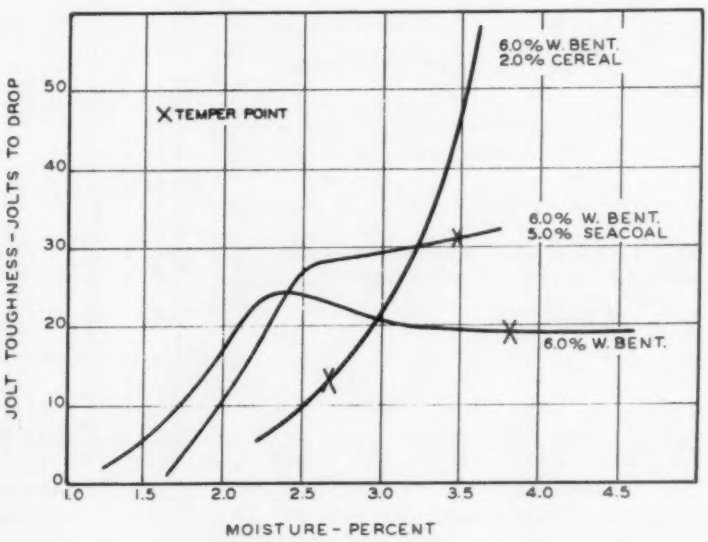

Fig. 9 — Cereal and sea coal addition materially changes the jolt toughness of bentonite bonded sand.

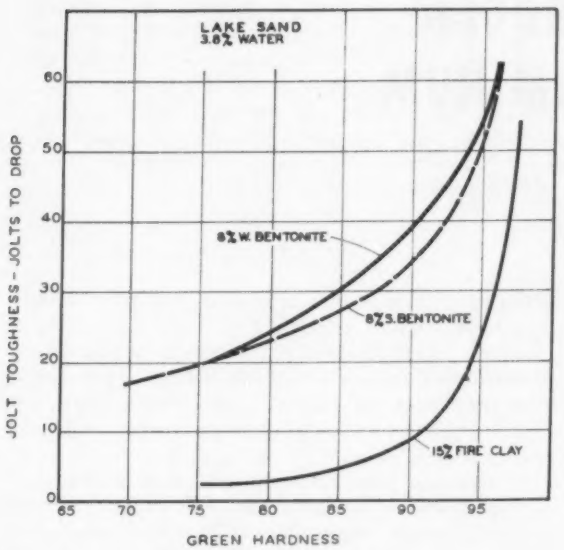

Fig. 10 — An increase in mold hardness increases the jolt toughness of a bentonite bonded sand.

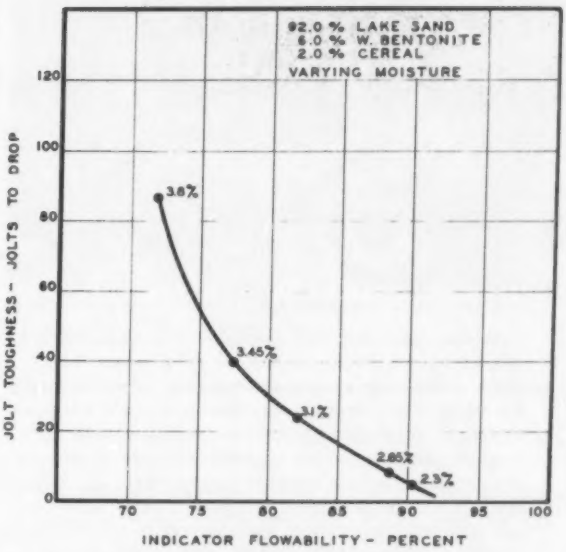

Fig. 11 — As the jolt toughness of a bentonite cereal-bonded sand decreases, the indicator flowability values increase, reducing false void spaces on mold wall surfaces.

CONCLUSIONS

A relationship exists between the shatter test and the jolt toughness test. On toughness above 70 for fireclay bonded sand, and 80 for bentonite bonded sand, the shatter test shows a slow increase in toughness. The jolt toughness test on the high toughness sands read progressively higher.

The jolt toughness does not vary greatly between Western and Southern bentonite bonded sands. The toughness of fireclay bonded sands show a different degree of toughness from bentonite bonded sands. The stress-strain sand toughness values bear a close relationship to jolt toughness values. The two tests undoubtedly measure the same mechanical property of a sand.

The jolt toughness of sand is not greatly affected by a change in grain fineness. An increase in bonding ingredient present in a sand that is plasticized with sufficient moisture increases jolt toughness. Bentonite bonded sands without additives rapidly develop a jolt toughness, and then reduce in toughness as temper is approached. The addition of silica flour materially reduces the jolt toughness.

The addition of certain wood flour materially reduces the jolt toughness in moisture range below temper. When moisture is above temper, the jolt toughness is increased. Many cellulose materials are great water carriers. The addition of cereal with low moisture materially reduces jolt toughness, but rapidly increases jolt toughness as moisture increases. The addition of sea coal at temper increases the jolt toughness.

The jolt toughness of sands increases as mold hardness increases. The greater the mold hardness, the more rapidly sand toughness increases. This is particularly true in the case of fireclay bonded sands. The sand offers greater resistance to flow as hardness approaches the high mold hardness, for example, 90 and above.

Sand toughness increases less rapidly in the low mold hardness range than in the higher mold hardness range. In this range, fireclay bonds increase more readily than do the bentonites. A relationship exists between the indicator flowability test values and the jolt toughness for a given sand. A low jolt toughness will allow reaching a high indicator flowability with the AFS sand rammer.

Tempering sands with just sufficient moisture to soften the clay substance to a controlled degree of plasticity, as measured by ultimate deformation, will yield a control over jolt toughness.

The use of additives produced high quality mold wall surfaces when the temper point by ultimate deformation was selected at a conservative value, for example, 0.018 to 0.020-in. range for iron and nonferrous sands. Herein lies a possibility on producing superior castings. A combination of an additive and improper moisture can lead to lower mold hardness and greater false void spaces.

It is well to study each sand mix separately—running careful laboratory tests and then ramming molds, noting mold hardness and false void spaces, then pouring the mold and making a careful study of castings. The quality of castings can be materially improved for a given standardized ramming by following a program discussed herein.

INITIAL BUBBLE TEST FOR DETERMINATION OF HYDROGEN CONTENT IN MOLTEN ALUMINUM

by D. J. Neil and A. C. Burr

ABSTRACT

An instrument has been designed for the determination of the hydrogen content of molten aluminum alloys, employing a method originally proposed by Dardel. The test involves maintaining a small sample of an aluminum alloy in the molten state while the pressure over the sample is slowly reduced. At some pressure less than one atmosphere, bubbles of gas will nucleate and break through the surface. This pressure and specimen temperature were related to the actual specimen hydrogen content as determined by the vacuum subfusion method, over a wide range of gas content. Sievert's Law was verified, and the constant of proportionality relating $\sqrt{p}$ and the hydrogen solubility was found to vary with alloy composition as expected. Nomograms were constructed wherewith hydrogen content could be determined quickly from the test data.

It is suggested that this test offers advantages over other tests for the determination of the hydrogen content of aluminum alloy melts, and that such determinations can be made with a precision of ± 0.05 ml H_2 at N.T.P./100g or better.

INTRODUCTION

In recent years great emphasis has been placed on quality control of wrought aluminum alloys. This is especially true where the finished products are critical components of aircraft or missiles. It is generally accepted that the hydrogen content of aluminum alloys is one of the factors which must be controlled, since in the processes of casting, thermal treatments and working, internal defects may occur which result directly or indirectly from an undesirably high melt hydrogen content.

Remedial measures such as gaseous fluxing of furnace charges will effect reductions in the hydrogen content, but since reproducible results are difficult to obtain, it is desirable, if not necessary, to be able to measure the hydrogen content of the molten metal.

Various methods have been used to this end over the years. The most common has been the Straube-Pfeiffer test or modifications of it, in which a small sample of molten aluminum alloy is permitted to solidify under a reduced pressure. During solidification hydrogen is rejected from solution and appears as porosity within the specimen. A qualitative estimate of the gas content is obtained from the convexity of the free surface or from the apparent density of the specimen.

Another method involves the casting of a specimen of controlled volume in a resin-bonded shell mold.[1] The proponents of this method claim to have obtained a good correlation between specimen density and hydrogen content.

A hydrogen content meter developed by Ransley[2] appears to be a promising tool, but experience with this equipment suggests that further development work is necessary to achieve characteristics necessary for convenient and low maintenance operation.

The apparatus described in the following paragraphs was developed jointly by Aluminium Laboratories Ltd. and the Aluminum Co. of Canada, Ltd. The method upon which the design is based was proposed initially by Dardel.[3,4]*

THEORY OF OPERATION

It is well known that the solubility of hydrogen in molten aluminum alloys varies with temperature and molecular hydrogen pressure according to the relationship

$$\log_{10} S = 0.5 \log_{10} p - \frac{A}{T} + B \qquad (1)$$

where

S = solubility in ml/100 g.
p = pressure in mm Hg.
T = absolute temperature (K).

and A and B are positive constants.

Values of the constants *A* and *B* for pure aluminum have been published by Ransley and Neufeld,[5] Opie and Grant[6] and Hofmann and Maatsch.[7] Opie and Grant also presented values of *A* and *B* for the binary systems Al-Cu and Al-Si.

Consider a sample of an aluminum alloy held above the melting point at temperature *T* and containing *S* cu cm of hydrogen. If the pressure over the sample were reduced below *p*, hydrogen would precipitate from solution and appear as bubbles. This aspect of the problem has been discussed by Dardel.[3]

Since it has been demonstrated that hydrogen solubility in aluminum alloys is affected by compositional

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*Since preparation of this paper an account of the application of the initial bubble test to hydrogen determination in light alloys has come to the attention of the authors. The reader is referred to M. V. Sharov and A. P. Gudchenko, "A Study of the Interaction of Hydrogen with Light Alloys during the Melting Process," *Metallurgicheskie Osnovy Lit'ya Legkikh Splavov*, Oborongiz, Moscow, p. 306 (1957).

changes, a calculation of the hydrogen content from the temperature T and pressure p at which bubbles of gas appear, is possible only if the constants A and B are known. Another approach is to obtain chill cast specimens corresponding to each set of values of T and p. The hydrogen content of these specimens is then determined by the vacuum subfusion or hot extraction method.[8] If all determinations of the pressure at which gas bubbles appear were made at the same temperature a calibration curve could be plotted directly; however, this is difficult in practice. Since for a given gas content and a temperature above the liquidus

$$\sqrt{p}\, e^{-\frac{k}{T}} = \text{constant} \qquad (2)$$

where

$$k = \frac{A}{\log_{10} e} \qquad (3)$$

then a knowledge of the constant A only, would enable one to adjust observed pressure data to a common reference temperature T_r. Ransley and Neufeld[5] found A to be 2760 while Opie and Grant[6] report 2550 for pure aluminum. These authors also report values of A from 2550 to 3150 for the binary systems Al-Cu (up to 32 per cent Cu) and Al-Si (up to 16 per cent Si).

Since

$$\sqrt{p_o}\, e^{-\frac{k}{T_o}} = \sqrt{p_r}\, e^{-\frac{k}{T_r}} \qquad (4)$$

where subscripts o and r signify observed and reference respectively, the effect of changes in the value of A may be calculated. The results are presented in Table 1.

TABLE 1 — EFFECT OF k ON CORRECTED PRESSURE DATA

	k = 5872	k = 6355	k = 7253
k/T_r	6.227	6.739	7.691
k/T_o	6.035	6.531	7.454
$k\left(\frac{1}{T_r}-\frac{1}{T_o}\right)$	0.192	0.208	0.237
$e^{k\left(\frac{1}{T_r}-\frac{1}{T_o}\right)}$	1.212	1.231	1.267

$T_o = 973$ K for illustration.
$T_r = 943$ K.

On the basis of the relatively small effect on the corrected values of $\sqrt{p}$, 6355 was chosen as a reasonable value of k for application to commercial aluminum alloys.

HYDROGEN CONTENT TESTER

The present form of the tester is illustrated in Fig. 1. Four basic components are involved, of which the vacuum pump is not shown. The instrument cabinet contains the pressure and temperature gages as well as a vacuum manifold, vacuum control valves and necessary outlets and switches to provide power to the vacuum pump and heater. The other two components are the heater unit and cover unit shown, respectively, in the right and left foreground of Fig. 1. The vacuum pump used has a free air capacity of 10 litres/min and a guaranteed vacuum of 0.3 microns Hg. Any pump of these characteristics will work with the tester.

Fig. 1 — Tester for the determination of the gas content of molten aluminum alloys.

The heater unit contains a boron nitride crucible of about 50 ml capacity, on the outside of which is wound directly a chromel A heater of 325 watts, rated at 115 volts A.C. The crucible heater assembly is located within a cast aluminum vessel. Heat losses are reduced by approximately 1½-in. of insulation between the crucible and the vessel walls and bottom. The crucible is held in place by means of a recess machined in the stainless steel cover on the heater unit. Electrical connections are brought out through the handle by means of hermetic seals.

The cover unit contains a glass viewing port sealed in position with O-rings, and a chromel-alumel thermocouple sheathed in stainless steel. The thermocouple leads pass through the handle of the cover unit and inside the rubber vacuum line to the manifold in the instrument cabinet, where they are brought out through hermetic seals to the temperature gage. The flange of the cover unit contains a recessed O-ring which mates with the flange integral with the heater unit to provide the vacuum seal.

The vacuum gage has an absolute pressure range of 0 - 200 mm Hg, and the temperature gage is compensated with a suitable thermistor to correct for variations in ambient temperature.

OPERATION

After having brought the crucible to the operating temperature and coated the stainless steel thermocouple sheath with a wash to prevent attack by molten aluminum, the instrument is ready for use.

Using a clean dry ladle a sample of molten metal is transferred into the tester crucible. The cover unit is placed over the heater unit, thus introducing the thermocouple into the specimen, and providing for continuous temperature measurement. The heater is so designed that metal held in the crucible will remain molten at a temperature which will eventually rise to approximately 760 C (1400 F). Having first closed the vacuum release valve the vacuum pump is switched on and the needle valve adjusted so that the pressure decreases at the rate of approximately 5 - 10 mm Hg/sec. Since the pressure gage is scaled from 0 - 200 mm Hg (absolute), the pointer will not

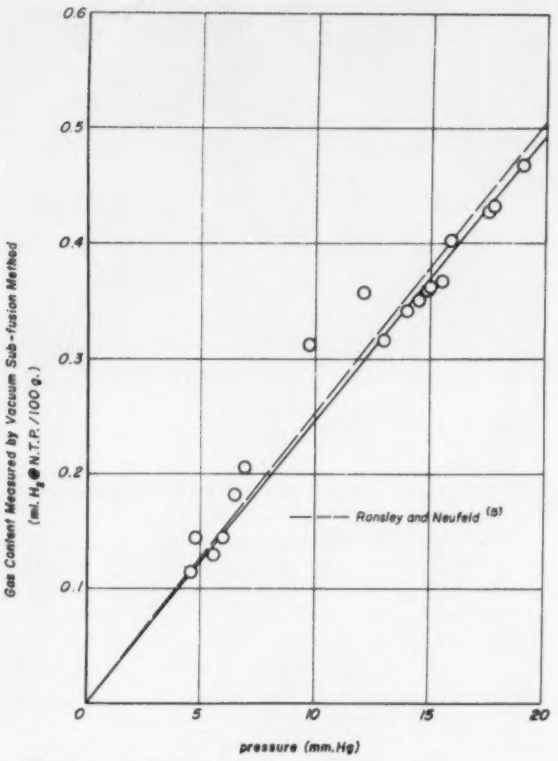

Fig. 2 — Calibration curve for aluminum 2S alloy.

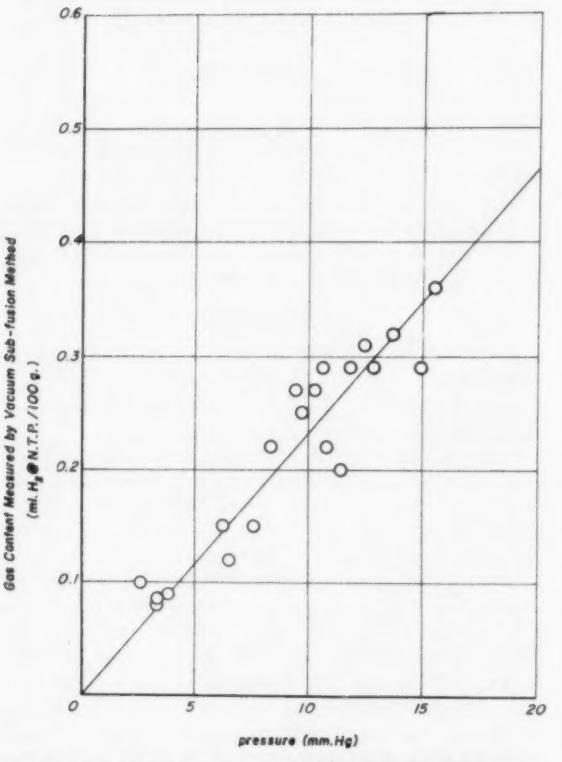

Fig. 3 — Calibration curve for aluminum 3S alloy.

move until the pressure has been reduced below 200 mm.

While the pressure is being reduced the specimen surface is observed with care. At some point bubbles of hydrogen will appear and the pressure and temperature are immediately noted. A further reduction in pressure will usually produce more bubbles to confirm the original observation. The pressure is then returned to atmospheric by switching off the vacuum pump and opening the vacuum release valve. It has been found desirable to make at least three observations on any melt since spurious indications occur occasionally. These spurious indications may result from air entrapped in dross adhering to the surface of the crucible. This possibility suggests that the crucible should be kept as clean as possible. It is also considered that spurious results might occur as a result of the presence of nuclei of solid foreign material within the specimen.

RESULTS

Small experimental melts were made up in aluminum alloys 2S, 3S, 57S and 75S compositions (Table 2) and chill-cast specimens were obtained covering a range of gas levels. Corresponding pressure and temperature data were obtained using the initial bubble test. The chill cast specimens were analyzed for hydrogen content by the vacuum subfusion method and the initial bubble test data were corrected to a reference temperature of 670 C (1400 F) using the relationship

$$p = p_o e^{2k\left(\frac{1}{T_r} - \frac{1}{T_o}\right)} \qquad (5)$$

where the subscripts have already been defined. The subfusion hydrogen content values were plotted against the square root of the corrected pressure values for the four alloys and the results are shown in Figs. 2, 3, 4 and 5.

TABLE 2 — CHEMICAL COMPOSITIONS FOR ALUMINUM ALLOYS EXAMINED*
(weight per cent)

Alloy	Aluminum Assoc. Equivalent	Cu	Fe	Mg	Mn	Si	Zn	Ti	Cr	Other Total
2S	1100	0.20	‡	—	0.05	‡	0.10	—	—	0.15
3S	3003	0.20	0.70	—	1.5	0.60	0.10	—	—	0.15
57S	5052	0.10	**	2.8	0.10	**	0.10	—	0.35	0.15
75S	7075	2.0	0.70	2.9	0.30	0.50	6.1	0.2	0.40	0.15

*All values quoted are upper limit.
‡Fe + Si = 1.0% Max.
**Fe + Si = 0.45% Max.

DISCUSSION

It will be noted that the results indicate the anticipated linear relationship between hydrogen content and $\sqrt{p}$. It will also be noted that the slopes of the best-fit lines have been altered as a result of compositional changes. Figure 2 shows the line plotted from data of Ransley and Neufeld[5] and the agreement is quite satisfactory. This agreement suggests that confidence may be placed in the method.

The scatter in the results appears to be more pronounced in the case of the stronger alloys. It has been decided that this fact can be attributed in part to the nature of the specimen oxide surface and the re-

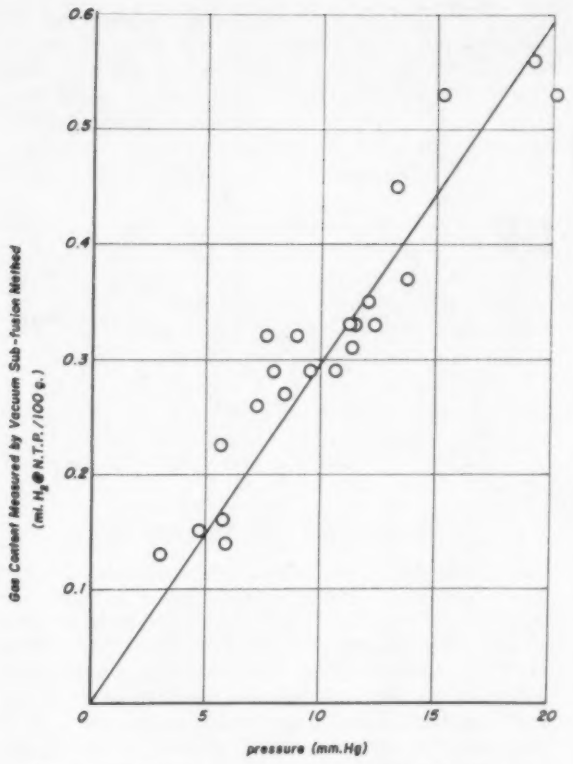

Fig. 4 — Calibration curve for aluminum 57S alloy.

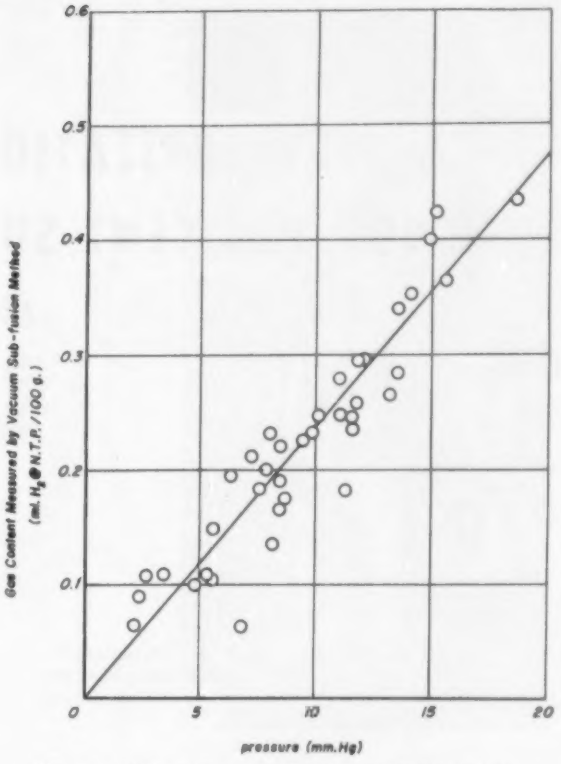

Fig. 5 — Calibration curve for aluminum 75S alloy.

lative difficulty in observing the first bubbles. In spite of the scatter, melt gas contents can be determined by this method within ± 0.05 ml H_2/100 g and furthermore, an individual determination can be made in approximately 2 min.

To facilitate interpretation of the pressure and temperature data from the test, it is possible to construct an appropriate nomogram. The nomogram scales are based on the previously mentioned assumption concerning the effect of temperature on hydrogen solubility. A sample nomogram is shown in Fig. 6.

The present evidence suggests that individual calibration curves may be necessary, especially in the case of major compositional changes. It is known for example, that silicon and copper additions depress the hydrogen solubility in aluminum while magnesium has the opposite effect.

The attractive feature of the method is the fact that actual melt hydrogen content in conventional units can be obtained in a matter of a few minutes. One must bear in mind, however, that the accuracy of gas content measurements appears to be more or less inversely proportional to the time involved in the determination. In spite of this the tester has been demonstrated to be a useful tool in melt gas content control.

REFERENCES

1. Sulinski, H. V. and Lipson, S., AFS Transactions, *vol. 67*, p. 56 (1959).
2. Ransley, C. E., Talbot, D. E. J. and Barlow, H. C., *J. Inst. Metals, 86*, 212, (1958).
3. Dardel, Y., *Metals Technology, 15*, 1, (1948).
4. Dardel, Y., *Metal Industry, 76*, 203, (1950).
5. Ransley, C. E. and Neufeld, H., *J. Inst. Metals, 74*, 599, (1948).
6. Opie, W. R. and Grant, N. J., *J. of Metals, 188*, 1237, (1950).
7. Hofmann, W. and Maatsch, J., *Z. Metallkunde, 47*, 89, (1956).
8. Ransley, C. E. and Talbot, D. E. J., *J. Inst. Metals, 84*, 445, (1956).

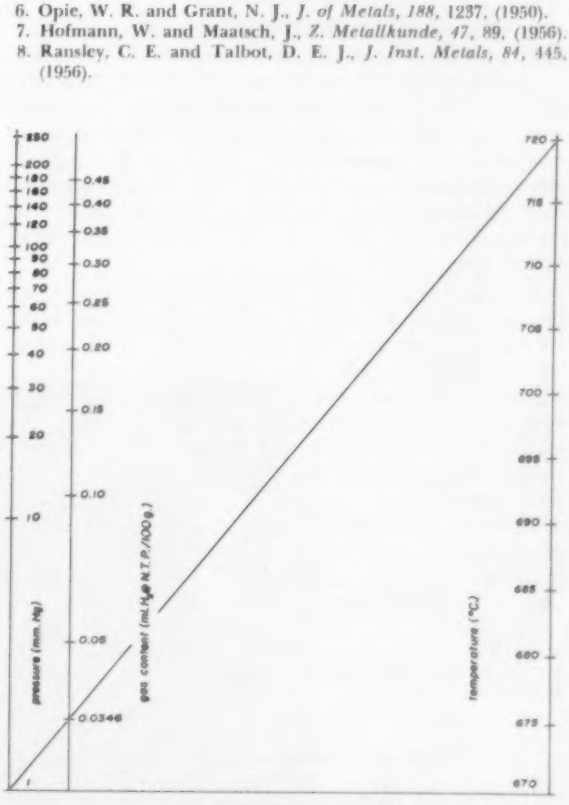

Fig. 6 — Nomogram for determination of hydrogen content of aluminum 2S alloy melts using tester data.

RAPID DESULFURIZATION TO 0.002 PER CENT SULFUR

by Edward J. Dunn, Jr.

ABSTRACT

The development of a simple desulfurization procedure that rapidly and consistantly reduces sulfur from initial values as high as 0.024 per cent to final residuals of 0.002/0.003 per cent is presented.

INTRODUCTION

Various investigations have shown that increasing amounts of sulfur in a steel composition decreases its ductility, toughness, hardenability and increases surface defects,[1] red-shortness[2] and porosity in welding.[3] Since the majority of these investigations were conducted with steels containing normal and higher sulfur residuals comparatively little data are available to show the influence of low sulfur levels (below 0.010 per cent) on the mechanical properties of steel.

The probable reasons for such limited data at the low sulfur levels are (1) the difficulty of present air melting practices to reproduce final sulfur levels below 0.010 per cent and (2) the alternative methods, such as using high purity melting stock and/or special vacuum techniques are not economically feasable for large tonnage production. Nevertheless, investigators such as Hodge et al[4] have shown that transverse toughness in a steel composition similar to 4330 can be as much as 50 per cent* greater when the sulfur is lowered from initial levels of 0.010 per cent to final residuals of 0.005 per cent, while further improvements might be expected at sulfur levels of 0.002 per cent sulfur.

The following investigation describes the development of an effective, reproducible and practical technique for the rapid desulfurization of steels to levels as low as 0.002 per cent sulfur, such that improvements in mechanical properties which are related to sulfur contents may be commercially realized.

Because of the author's immediate interest in silicon modified aircraft steels, effort in this investigation was concentrated on the desulfurization of a 4340 composition modified with 1/1.5 per cent Si.

GENERAL CONSIDERATIONS

Sulfur in steel is reduced in the arc furnace by the use of a strongly basic and reducing carbidic slag, and is generally represented by chemical reactions such as:

$$2CaO + CaC_2 + 3FeS = 3CaS + 2CO + 3Fe^{5}$$

This reaction occurs at the slag-metal interface, and is limited in its effectiveness because of the small metal-to-slag contact and the poor sulfur diffusion through the apparent metal and slag boundary layers. This, consequently, necessitates long refining times under the reducing slag in order to reduce the sulfur to any appreciable degree.

It can be assumed that a more rapid and effective sulfur removal can be accomplished if the desulfurizing reaction is brought into intimate contact with the greater bulk of the metal. One way to accomplish this is by immersing an element or compound (which forms an insoluble stable sulfide) into the metal bath, and permitting the sulfide reaction to occur through the mass of the metal rather than at the slag-metal interface.

Of the more familiar sulfide forming elements, Ce, Ca and Mg can be considered to form some

*These values were compared at the 40 Rc and the 300 F test temperature.

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(Work on this paper was performed when the author was associated with Watertown Arsenal, Rodman Laboratory, Watertown, Mass.)

of the most stable sulfides at steel making temperatures, as indicated by their relative standard free energy of formations,[6] i.e., the greater the negative free energy of formation of a compound, the greater is its probable stability.

Of these three sulfides, CeS has the highest negative standard free energy of formation at steel making temperatures with CaS somewhat smaller and MgS with the lowest negative standard free energy. Since Ce is available in limited quantities and at a relatively premium price, the formation of CeS by the use of Ce would not be economically feasible, while the formation of MgS by the use of elemental Mg presents a possible explosive hazard.

Thus an investigation into the effect of a Ca immersion in a steel bath holds the greatest immediate promise of a practical and economical technique for rapid desulfurization of steel.

Fig. 1 — Complete holding device showing cup container at bottom, rod attachment, weight and crane loop on top.

EXPERIMENTAL PROCEDURE

Using the required conditions presently known for effective desulfurization in the arc furnace, such as a strongly basic and reducing slag,[5] and adding to this the supposition that desulfurization can be more readily accomplished if an element (or compound) which forms a stable sulfide is added directly into the metal bath, this procedure was devised:

1. Melt down in a basic-lined furnace.
2. Skim off melt down slag to remove as many acid melt down constituents as possible.
3. Reduce or deoxidize the bath directly, rather than via a reducing slag, by the addition of a normal amount of Al (0.1 per cent) (This was done at 2900 F).
4. Immediately add unslaked lime to a depth of one to 2 in. to form a strongly basic slag.
5. At a temperature high enough to prevent freeze-up (2900 F), take a metal sample for a complete chemical analysis (including sulfur), and immediately inject Ca into the metal bath at arbitrary amount of 0.6 per cent of the charge.

Because of the cost of metallic Ca, it was immediately substituted by a cheaper form of Ca, i.e., CaMnSi and the bulk of the investigation was conducted with CaMnSi which was added in sufficient quantities to produce a 1.0/1.5 per cent Si residual (2 per cent CaMnSi). This Ca or CaMnSi was injected into the bath by means of an expanded metal screen cage attached to a long weighted bar and manipulated by a crane (Figs. 1-4).

6. Tap immediately (The additions cooled the metal approximately 80 F, resulting in a desirable tapping temperature of approximately 2820 F).

Fig. 2 — Closeup of cup container with CaMnSi inside.

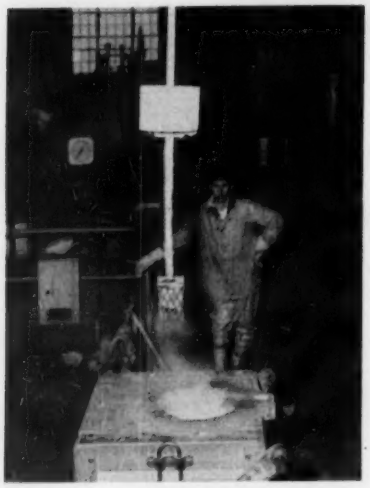

Fig. 3 — The Ca-MnSi and its holding device before lowering into furnace.

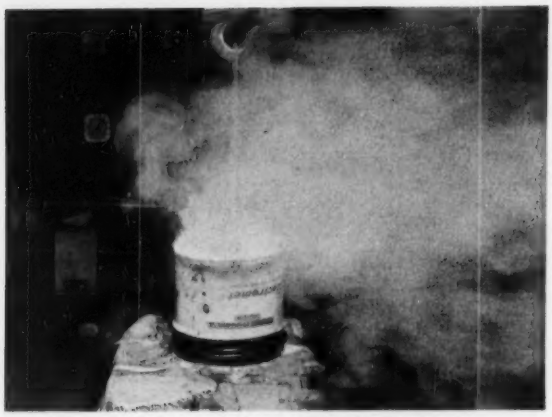

Fig. 4 — Reaction caused by CaMnSi injection.

Induction furnaces of 300 and 600 lb capacities were used in the development of the desulfurization procedure, afterwhich it was proved on 1000 and 2400 lb induction furnace melts.

RESULTS AND DISCUSSION

The proposed method of desulfurization quickly and effectively reduced the sulfur content of a medium alloy steel from average initial sulfur contents of 0.020 per cent to final residuals of 0.006 per cent (Table 1). Excessive ingot porosity and a drastic Al reduction was observed with this desulfurization, and it was necessary to increase the Al deoxidation from 0.1 to 0.15 per cent to eliminate this porosity. With such a modification in the procedure, not only was the porosity eliminated but desulfurization was also increased. For example, when the Al addition was increased to 0.15 per cent the same Ca or CaMnSi addition reduced the original average sulfur contents of 0.022 per cent to final average sulfurs of 0.002 per cent (Table 2).

This desulfurization occurred rapidly, for an analysis of the metal pin samples taken immediately before and after the Ca or CaMnSi addition showed that the greater bulk of the sulfur was immediately reduced while only a little desulfurization occurred during tapping, i.e., a 0.002 per cent sulfur reduction generally occurred during tapping. Along with the sulfur and Al reduction in the metal and their apparent subsequent increase in the slag, an increase of Fe, Mn and Si in the slag was also suggested by typical slag analysis taken before and after 2 per cent CaMnSi additions (Table 3). The reported reduction of CaO in the slag after the addition is apparently the reflection of an increase in one or all of the other constituents in the slag.

TABLE 1 — DESULFURIZATION WITH INITIAL MELTING PRACTICE

Heat No.	Per Cent									Wt. of Addition/Wt. of Charge, %	Type of Addition
	C	Mn	Si	Ni	Cr	Mo	P	S	Al	Al (added)	
1	0.24 (B.A.) *	0.51	0.23	1.78	0.88	0.34	—	0.019	0.08	0.1	2	CaMnSi
	0.24 (A.A.) **	0.71	1.02	1.76	0.81	0.31	—	0.006	0.02			
2	0.32	0.77	0.28	1.76	0.89	0.33	0.012	0.016	0.05	0.1	2	CaMnSi
	0.30	1.12	1.22	1.72	0.80	0.31	0.009	0.005	0.02			
3	0.33	0.82	0.24	1.83	0.84	0.31	0.009	0.024	0.07	0.1	2	CaMnSi
	0.33	1.11	1.65	1.80	0.90	0.29	0.009	0.005	0.02			
4	0.36	0.86	0.24	1.72	0.82	0.32	0.012	0.017	0.05	0.1	2.3	CaMnSi
	0.36	1.20	1.44	1.67	0.84	0.30	0.012	0.003	0.02			
5	0.42	0.66	0.15	1.93	0.97	0.32	0.010	0.022	0.07	0.1	2.3	CaMnSi
	0.42	0.92	1.25	1.84	0.97	0.29	0.011	0.005	0.03			
6	—	—	—	—	—	—	0.010	0.025	—	0.1	0.6	Ca
	1.12	0.86	0.08	1.72	0.79	0.25	0.007	0.005	0.01			
7	0.22	0.84	0.10	1.90	1.07	0.33	0.010	0.022	0.05	0.1	+0.6	CaMnSi
	0.22	0.92	0.31	1.87	1.00	0.32	0.010	0.006	0.03		0.3	plus Ca

* Before addition.

** After addition and taken in the ladle.

TABLE 2 — INCREASED ALUMINUM EFFECT

Heat No.	Per Cent C	Mn	Si	Ni	Cr	Mo	P	S	Al	Al (added)	Wt. of Addition/Wt. of Charge, %	Type of Addition
8	0.34 (B.A.) *	0.38	0.15	1.90	5.05	0.27	0.008	0.020	0.13	0.15	2	CaMnSi
	0.34 (A.A.) **	0.84	1.70	1.85	4.78	0.25	0.008	0.002	0.05			
9	0.47	0.68	0.16	1.90	0.76	0.25	0.008	0.006	0.16	0.15	0.6	Ca
	0.45	0.69	0.21	1.80	0.78	0.26	0.007	0.003	0.05			
10	0.24	0.75	0.05	1.91	0.92	0.27	0.006	0.019	0.11	0.15	+0.3	CaMnSi
	0.24	0.80	0.33	1.93	0.88	0.27	0.008	0.003	0.06		0.3	Ca
11	0.69	0.35	0.09	1.75	0.85	0.25	0.009	0.005	0.10	0.15	2	CaMnSi
	0.67	0.87	1.59	1.63	0.83	0.23	0.009	0.002	0.07			
12	0.40	0.45	0.03	1.85	0.87	0.26	0.008	0.022	0.07	0.15	2	CaMnSi
	0.40	0.72	0.93	1.83	0.87	0.25	0.009	0.003	0.02			
13	0.39	1.00	0.06	1.30	—	0.29	0.009	0.023	0.11	0.15	2	CaMnSi
	0.40	1.29	1.12	1.26	—	0.28	0.009	0.003	0.09			

* Before addition.
** After addition and taken in the ladle.

TABLE 3 — TYPICAL SLAG ANALYSIS TAKEN BEFORE AND AFTER THE CaMnSi ADDITION

Heat	Per Cent CaO	MgO	MnO	FeO	SiO_2	P_2O_5	Al_2O_3	S
A	80.1*	1.1	0.4	6.1	4.1	0.07	2.9	0.414
	73.6**	1.2	0.4	9.7	5.3	0.10	2.8	0.450
B	76.5	0.2	0.1	4.4	3.1	0.04	2.0	0.15
	73.9	0.2	0.4	11.0	4.7	0.14	2.9	0.29
C	74.3	0.2	0.2	3.2	2.0	0.03	1.5	0.125
	69.5	0.2	0.5	13.2	7.5	0.09	2.0	0.210

* Before the CaMnSi addition.
** After the CaMnSi addition.

TABLE 4 — INCREASED LIME ADDITIONS EFFECT

Heat No.	Per Cent C	Mn	Si	Ni	Cr	Mo	P	S	Al	Lime Added to Bath Surface, %
14	0.37 (B.A.) *	0.34	0.10	—	—	0.26	0.010	0.024	0.11	0
	0.36 (A.A.) **	0.62	1.08	1.75	0.96	0.28	0.008	0.017	0.06	
15	0.37	0.35	0.10	1.76	0.96	0.28	0.008	0.024	0.11	1.6
	0.37	0.67	1.38	1.76	0.96	0.28	0.008	0.006	0.05	
16	0.32	0.30	0.10	1.76	0.93	0.26	0.010	0.019	0.12	2.0
	0.32	0.59	1.20	1.74	0.90	0.25	0.001	0.003	0.07	
17	0.36	0.41	0.19	1.86	0.83	0.25	0.009	0.022	0.11	2.5
	0.36	0.81	1.44	1.74	0.87	0.25	0.009	0.003	0.05	
18	0.36	0.33	0.18	1.88	0.93	0.26	0.008	0.024	0.10	3.0
	0.35	0.72	1.23	1.78	0.92	0.25	0.008	0.004	0.04	
19	0.37	0.33	0.12	1.93	0.98	0.27	0.007	0.024	0.11	3.2
	0.38	0.62	1.19	1.78	0.96	0.29	0.009	0.004		
20	0.39	0.39	0.12	1.81	0.98	0.25	0.007	0.025	0.10	3.5
	0.39	0.72	1.08	1.75	0.98	0.24	0.009	0.003	0.03	
21	0.33	0.35	0.09	1.86	0.96	0.25	0.007	0.021	0.12	4.0
	0.32	0.74	1.22	1.79	0.94	0.26	0.009	0.003	0.05	
22	0.36	0.38	0.08	1.81	0.85	0.25	0.007	0.022	0.10	5.0
	0.35	0.67	0.99	1.81	0.87	0.24	0.008	0.003	0.03	
23	0.38	0.40	0.12	1.81	0.99	0.26	—	0.025	0.11	6.0
	0.36	0.68	1.16	1.78	0.99	0.25	—	0.001, 0.002	0.05	

(The heats were 300 lb melts in which 0.15% Al + 2% CaMnSi was added)

* Before addition.
** After addition and taken in the ladle.

Fig. 5 — Comparison of as-cast cleanliness in various melting practices. *Left to right* — 4340 steel produced in a basic induction furnace, 4340 steel produced in a basic arc furnace, 4340 (1.5 per cent Si) steel produced in a basic induction furnace using the desulfurizing method of this investigation and 4340 steel produced in a basic induction furnace under vacuum. Unetched. 100 ×.

In addition to using a sufficient Al addition, and the proper technique for adding Ca or CaMnSi, a sufficient quantity of lime must be added to the bath surface before effective desulfurization can be obtained. As Table 4 indicates, for identical practices except for the lime additions, insignificant sulfur reduction was effected when lime was not available at the metal surface and the melt was left completely exposed to the atmosphere. But as the lime addition was increased, increased desulfurization was possible such that at a 6 lb/100 lb charge, desulfurization to levels as low as 0.001/0.002 per cent was obtained.

It is noteworthy to mention the fact that not only did this procedure produce steel with extremely low sulfur residuals, but the cleanliness of the steel was improved considerably and can be compared to vacuum induction melted steel (Fig. 5). The inclusions in these micrographs were not identified, but it is readily seen that the type of inclusions resulting from the desulfurization practice were of the more desirable Type 1, while the arc and the normal induction furnace melts contained considerable amounts of undesirable Type 3 inclusion.

When the desulfurizing procedure developed in this paper was tested on 1000 lb and 2400 lb melts similar results were obtained.

SUMMARY AND CONCLUSION

Sulfur content of a medium carbon, medium alloy steel can be quickly, effectively and consistently reduced to 0.002/0.003 per cent whenever this procedure is followed:

1. Melt down in a basic lined furnace.
2. Remove melt down slag.
3. Deoxidize the metal bath with 0.15 per cent Al (more recent investigations indicate that greater quantities of Al may be necessary in low carbon melts).
4. Add lime in minimum quantities of 2 lb/100 lb charge (6 lb/100 lb charge is required if 0.001/0.002 per cent sulfur is desired).
5. At a sufficiently high enough temperature to prevent freezeup, immerse 2 lb/100 lb of charge of CaMnSi into the steel bath.
6. Tap at the desired temperature.

REFERENCES

1. Am. Iron and Steel Inst., *Year Book of American Iron and Steel Institute*, p. 322 (1949).
2. A. Josefsson, J. Koeneman and G. Lagergerg, "The Influence of Sulphur and Oxygen in Causing Red-Shortness in Steel," *J. of Iron and Steel Inst., vol. 191* (March 1959).
3. *Metals Handbook*, p. 451 (1948).
4. J. M. Hodge, R. H. Fraizer and F. W. Boulger, "The Effect of Sulfur on the Notch Toughness of Heat-Treated Steels," *Transactions of the Met. Soc. of A.I.M.E., vol. 214*, No. 5, p. 745 (Oct. 1959).
5. J. M. Camp and C. B. Francis, *The Making, Shaping and Treating of Steel*, p. 514.
6. Darken and Gurry, *Physical Chemistry of Metals*, McGraw-Hill Book Co., Inc., p. 361 (1953).

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NEWS and VIEWS

International Congress June 18-24
Dues Revision Aids Research
Elect New AFS Officers, Directors

New Techniques for Expanding Foundry Markets Emphasized at 65th AFS Castings Congress

Foundries and their role in the future received chief emphasis during the 65th AFS Castings Congress held May 8-12 in San Francisco. Center of attraction were the more than 100 technical papers dealing with all phases of the metalcasting industry, present and future. The Congress was attended by 1644 persons.

Considerable stress was placed on the potential inroads in the aircraft and missile fields if metalcasters can meet the necessary quality standards. Authors pointed out that new technology or utilizing techniques to the maximum could open doors.

The tone of the Congress was set by keynoter Jack B. Caine who presented the Hoyt Memorial lecture.

"The designer and engineer have been taught that castings make second grade parts. They have been taught that metal must be wrought for maximum physical properties. This

Caine challenged foundrymen to take advantage of cast metals through proper design. He emphasized that the foundry industry as a whole must be familiar with function, casting flexibility, ductility, fatigue failure, and the entire ramification of design.

Concluded Cane, "The foundry industry is not dying, but it is not growing. Casting design offers the hope of reversing this trend to make castings lead the parade rather than to take a back seat to newer, better promoted forming processes."

Active and increasing membership participation in all AFS affairs was urged by President N. J. Dunbeck in his final summary report.

This is especially important in the major technical divisions and committees, he stated. "Last year these committees held over 75 meetings to develop technical programs, supervise research projects, prepare publications on foundry practice, and evaluate means of producing better products," the President observed.

Two AFS projects were cited for their contributions. These were the AFS Training & Research Institute and the Safety, Hygiene & Air Pollution Control Program.

Technical papers were supplemented by division-sponsored shop courses and luncheons. A plant visitation program was conducted by 22 San Francisco area foundries and a special program was held for ladies.

The most important single day in Society activities took place on May 10. The annual Business Meeting was held in the morning and the annual Banquet and award of Gold Medals in the evening.

Albert L. Hunt, executive vice-president, Superior Foundry, Inc., Cleveland, was elected as AFS President for the 1961-62 term. John A. Wagner, president, Wagner Castings Co., Decatur, Ill., was selected as AFS Vice-President.

New Directors are:

Daniel E. Best, superintendent, Brass & Iron Foundries, Bethlehem Steel Co., Bethlehem, Pa.

Roger J. Hageboeck, vice-president, Frank Foundries Corp., Moline, Ill.

Dale Hall, works manager, Oklahoma Steel Castings Co., Div. American Pump Corp., Tulsa, Okla.

C. J. Lonnee, president, Alloyed Grairon Castings Corp., Ravenna, Mich.

Charles Ossenfort, foundry superintendent, Fairbanks, Morse & Co., Kansas City, Kans.

Carl O. Schopp, assistant general superintendent, Link Belt Co., Indianapolis.

M. E. Nevins, president, Wisconsin Centrifugal, Inc., Waukesha, Wis., elected as a director-at-large for a three-year term by the Board of Directors begins his term with the directors elected at the Congress.

Retiring AFS President, N. J. Dunbeck, vice-president, International Minerals & Chemical Corp., Skokie, Ill., automatically serves a one-year term as director.

AFS Gold Medals were awarded to M. C. Flemings, Jr., assistant professor of metallurgy, Massachusetts Institute of Technology, Cambridge, Mass., and W. S. Pellini, head, metallurgy dept., Naval Research Laboratories, Washington, D. C.

Awards of Scientific Merit were granted H. E. Henderson, technical director, research dept., Lynchburg Foundry Co., Lynchburg, Va.; H. J. Weber, AFS Director of Safety, Hygiene and Air Pollution Control Program; and T. R. Schroeder, foundry superintendent, Pontiac Motor Div., General Motors Corp., Pontiac, Mich.

AFS Service Citations were presented to Jess Toth, vice-president, sales, Harry W. Dietert Co., Detroit; K. M. Smith, staff engineer, Caterpillar Tractor Co., Peoria, Ill.; and A. D. Barczak, operations vice-president, Superior Foundry, Inc., Cleveland.

AFS officials take breather during Castings Congress. Recognizing friends on left is Albert L. Hunt who succeeds N. J. Dunbeck, center, as AFS President. John A. Wagner, right, becomes the new AFS Vice-President.

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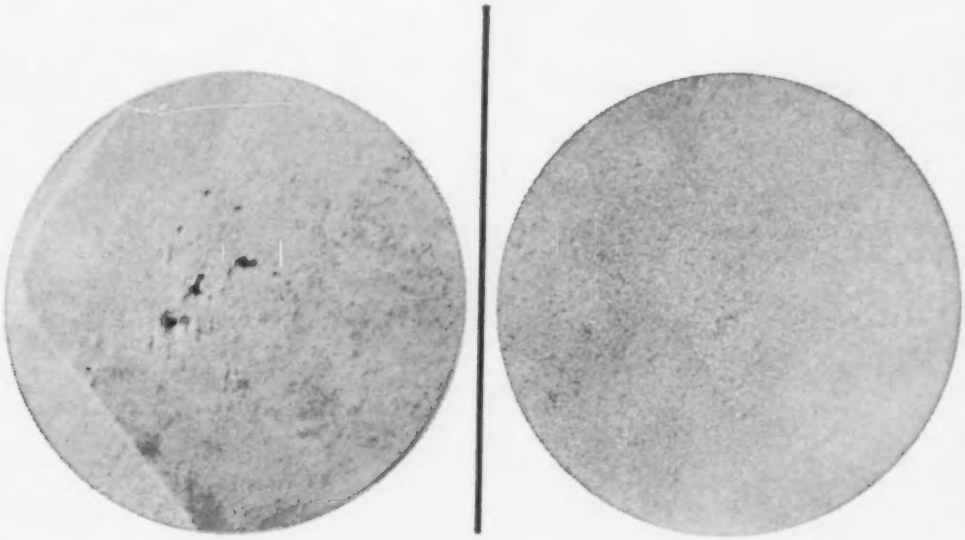

Sand casting at left shows typical surface shrinkage. Sand casting at right, produced under same casting conditions, was made from Federated PT Grade ingot.

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Circle No. 158, Pages 127-128

Broadening AFS Research Calls for Dues Revision

A significant and much-needed revision in dues—the first since 1953—has been voted by the Board of Directors, American Foundrymen's Society. Effective July 1, the new dues structure makes possible the following:

1. It helps the metalcasting industry to compete technologically with other industries such as plastics, weldments, and forgings. AFS is the *one* society which represents all facets of metalcasting.

2. It continues a well-charted technological program embracing all phases of metalcasting.

3. It permits the development of new fundamental research programs considered a "must" today for growth and improvement of metalcasting.

With the Society battling for many years against rising costs, meeting growing technological needs of the industry, and servicing ever-increasing requests of AFS members for vital help, prompt action was thus deemed essential.

An important innovation is the establishment of a new class of membership, the Research Patron. This classification has been created to promote increased research on fundamental studies of cast metals and their behavior. Since 1946 the Society has sponsored and financed such projects from current operating funds.

The new dues structure:

Class	Present Rates	New Rates
Research Patron	—	$1000
Sustaining	$300 min.	400 (flat)
Company	100	150
Affiliate	10	15
Associate	10	15
Junior	4	5

Action on the dues revision was precipitated this year by two factors: (1) cancellation of the scheduled 1961 AFS Exposition because of business conditions and insufficient exhibitor support, and (2) fluctuating income in the last 10 years, including several deficits.

However, the Society is in a sound financial position. A strong reserve—built up throughout the years—is making it possible to maintain present activities.

Despite an unfavorable income trend, AFS has sponsored "must" programs to strengthen its technical effort and to improve the competitive position of foundries. These include:

- Safety, Hygiene and Air Pollution Control Programs
- Chapter Officers Conferences
- Technical Council Meetings
- Training and Research Institutes
- Publications and Special Technical Reports
- Monthly Publication of New Technology in MODERN CASTINGS

Fortunately, MODERN CASTINGS is a profitable and growing operation. As a business publication, the great majority of its revenue is derived from advertising. If it were not for this income, it would cost each member more than $22 a year for a subscription.

Establishment of the Research Patron classification is expected to materially strengthen fundamental research. AFS-T&RI projects are confined to basic research as opposed to applied research.

In the past few years a number of potentially valuable projects have been deferred for a lack of funds. Support of the Research Patron program will aid in both broadening research and increasing the number of projects available.

Activities of the Society have greatly increased since the dues structure was last revised in 1953. Among these are:

- Completion of the AFS Headquarters
- AFS Library
- Training & Research Institute

Since 1953 more than 25 publications have been completed dealing with all phases of cast metals practice at a net expense of $32,000 for the eight-year period.

The declining income is clearly demonstrated by net income and expense figures during the past decade. Deficits are shown in parentheses.

Budget Years	2-Year Net Income or (Expense)
1950-1952	$130,200
1952-1954	111,900
1954-1956	(5,400)
1956-1958	54,300
1958-1960	(36,300)

The decline was only temporarily corrected with a dues increase in 1953, the last time the dues structure was revised.

The fiscal year 1958-59 closed with an excess expense of $187,900, the largest ever in the Society's history. This was followed by an excess of income of $151,600 in 1959-60 which will be cancelled by an estimated 1960-61 loss of approximately $150,000. During the 1960-61 fiscal year, cancellation of the Exposition in San Francisco due to insufficient exhibitor participation, wiped out anticipated revenues.

New National Directors

D. B. Best

N. J. Dunbeck

R. J. Hageboeck

D. L. Hall

C. J. Lonnee

M. E. Nevins

C. H. Ossenfort

C. O. Schopp

"I'LL TAKE A MILLION TONS..."

Wish he would stop bothering us! Tempting as it is to receive such a big order from the Otherworld's No. 1 Heating Expert — we've got a firm policy to sell only *good* guys.

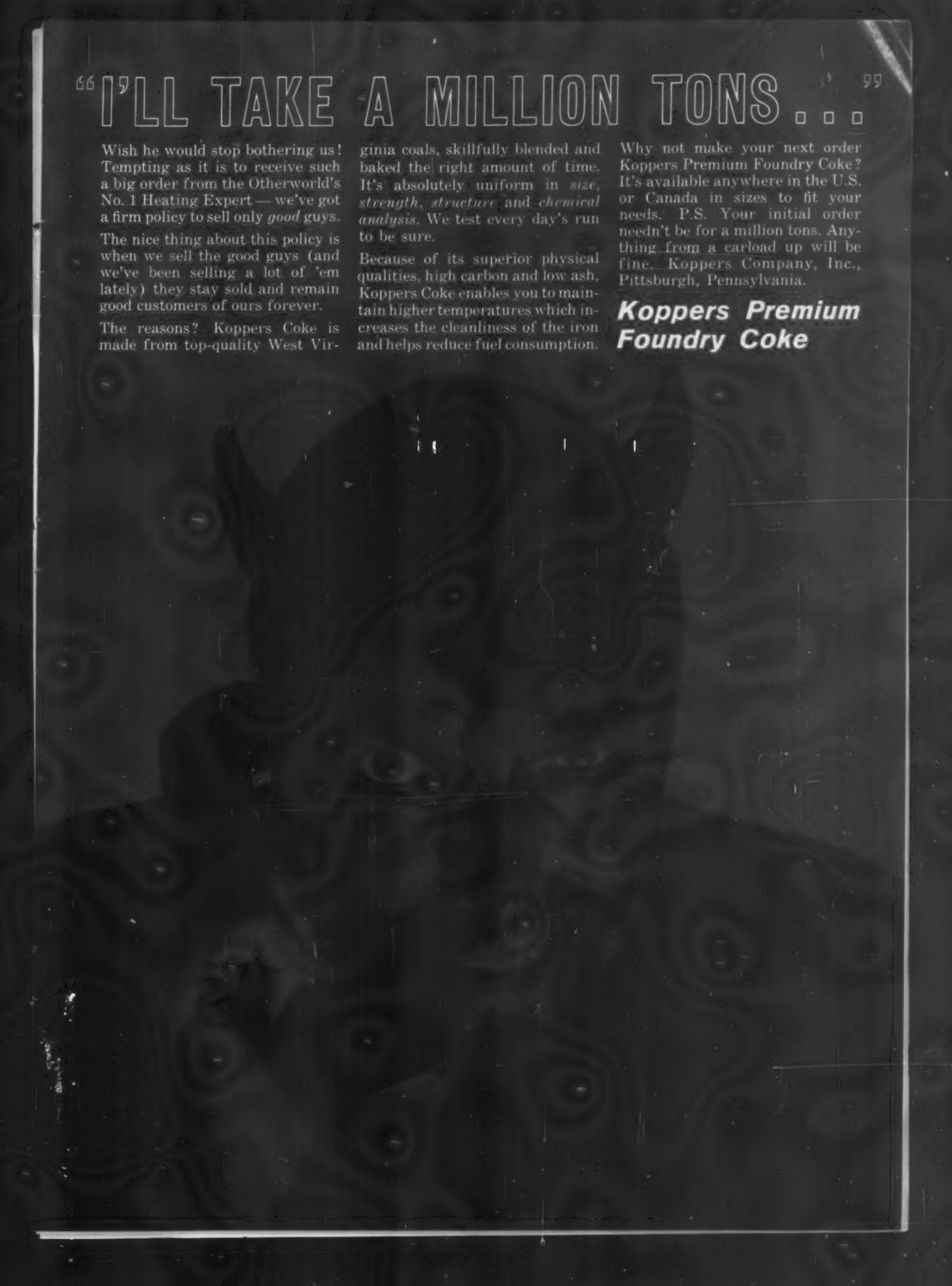
The nice thing about this policy is when we sell the good guys (and we've been selling a lot of 'em lately) they stay sold and remain good customers of ours forever.

The reasons? Koppers Coke is made from top-quality West Virginia coals, skillfully blended and baked the right amount of time. It's absolutely uniform in *size, strength, structure* and *chemical analysis*. We test every day's run to be sure.

Because of its superior physical qualities, high carbon and low ash, Koppers Coke enables you to maintain higher temperatures which increases the cleanliness of the iron and helps reduce fuel consumption.

Why not make your next order Koppers Premium Foundry Coke? It's available anywhere in the U.S. or Canada in sizes to fit your needs. P.S. Your initial order needn't be for a million tons. Anything from a carload up will be fine. Koppers Company, Inc., Pittsburgh, Pennsylvania.

Koppers Premium Foundry Coke



Largest Apprentice Contest Draws 129 Entries, Winners from Coast-to-Coast

Judges for the 1961 Robert E. Kennedy Memorial Apprentice Contest poured over 129 entries, the largest ever assembled in the national competition, to select four apprentices from the United States and one from Canada as this year's winners.

A record 20 chapters submitted entries this year. The wide interest in the annual contest was demonstrated by the geographical location of the winners. Patternmaking honors were taken by apprentices in Ohio and Michigan, while molding awards went to Rhode Island, Oregon, and Vancouver, British Columbia. The 129 national contest entries represented the best of over 465 original starters.

Chapters participating in the annual event included British Columbia, Canton, Central Illinois, Central Indiana, Detroit, Eastern Canada, Metropolitan (New York City), Northern Illinois-Southern Wisconsin, North East Ohio, Ontario, Oregon, Philadelphia, Pittsburgh, Quad City, St. Louis, Southern California, Twin City (Minneapolis-St. Paul), Washington, Wisconsin, and Wentworth Institute Student Chapter.

Name Prize Winners

Top award in wood patternmaking went to Kenneth E. McGarr, Poppenger & Howell Co., Akron, Ohio. Second award in this field went to Donald E. Kuenzel, Central Pattern Co., St. Louis, and Alan E. Larson, Progress Pattern Co., Detroit, received the third place certificate and prize.

In metal patternmaking, the first award went to James S. Arnold, also of Progress Pattern Co. in Detroit. Hans Joachim Thiel, Caterpillar Tractor Co. in Peoria, Ill. took the second award, and Raymond J. Laudi, Aluminum Co. of America, Cleveland, placed third.

First award in the steel molding division went to Donald A. Sprague, Columbia Steel Casting Co., Portland, Ore. Runner up in this area was Donald L. Mallder, Rock Island Arsenal, Rock Island, Ill., and Siegfried G. Mueller, Electrocast Steel Foundry, Chicago, placed third.

Top spot in gray iron molding went to William Mulvey, Brown & Sharpe Co., Providence, R. I. Second award was presented to Jack V. Bogaert, International Harvester Co., Indianapolis, and the third award prize and certificate was given to Stanley L. Purvis, Rock Island Arsenal.

In the non-ferrous molding division, Wayne Belanger, Bird Aluminum Foundry, Ltd., Vancouver, British Columbia, was named first award winner. Wayne Maxey, Wisconsin Aluminum Foundry Co., Manitowac, Wis., took second place honors, and Edwin D. Lasecki, Zandt Brass Foundry, Inc., Seattle, Wash., placed third.

For this year's contest, Garvey Pattern & Mfg. Co., South Bend, Ind., made the pilot scale model of the wood pattern and the finished drawings. U. S. Gypsum Co., Chicago, produced 20 patterns for the molding competition.

The contest throughout the country attracted apprentices working for some 171 individual companies.

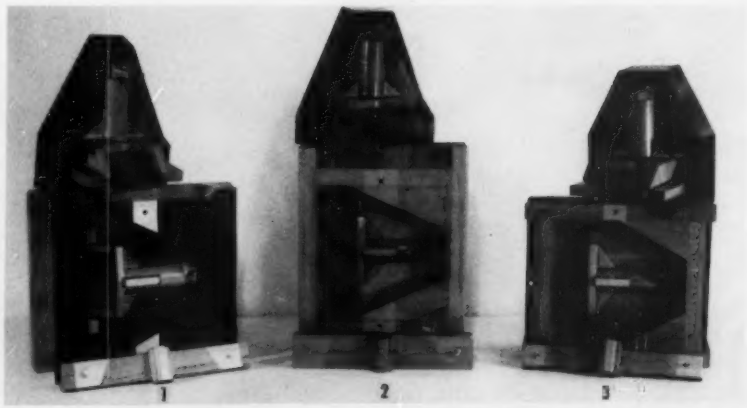
Kenneth E. McGarr
First Award
Wood Patternmaking

Donald A. Sprague
First Award
Steel Molding

James S. Arnold
First Award
Metal Patternmaking

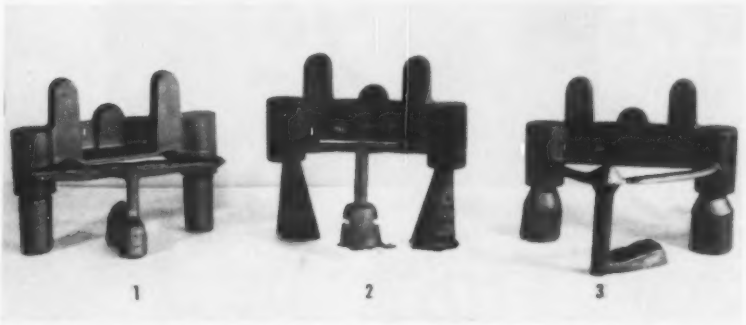
William Mulvey
First Award
Gray Iron Molding

Wayne Belanger
First Award
Non-Ferrous Molding



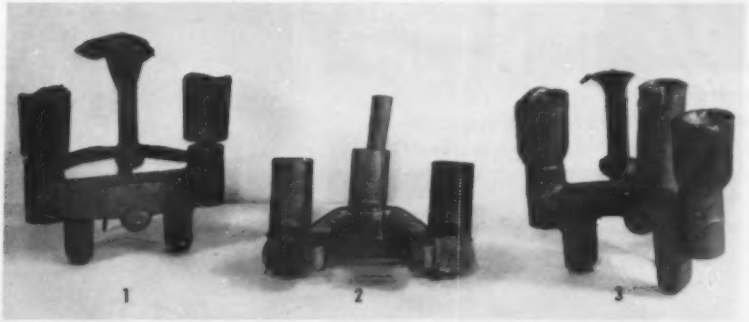
WOOD PATTERNMAKING—1st Award, Kenneth E. McGarr, Poppenger & Howell Co., Akron, Ohio; 2nd Award, Donald E. Kuenzel, Central Pattern Co., St. Louis; 3rd Award, Alan E. Larson, Progress Pattern Co., Detroit.

METAL PATTERNMAKING—1st Award, James S. Arnold, Progress Pattern Co., Detroit; 2nd Award, Hans Joachim Thiel, Caterpillar Tractor Co., Peoria, Ill.; 3rd Award, Raymond J. Laudi, Aluminum Co. of America, Cleveland.



GRAY IRON MOLDING—1st Award, William Mulvey, Brown & Sharpe Mfg. Co., Providence, R. I.; 2nd Award, Jack V. Bogaert, International Harvester Co., Indianapolis; 3rd Award, Stanley L. Purvis, Rock Island Arsenal, Rock Island, Ill. (The castings were inverted in this photograph so they would stand alone)

NON-FERROUS MOLDING—1st Award, Wayne Belanger, Bird Aluminum Foundry, Ltd., Vancouver, British Columbia; 2nd Award, Wayne Maxey, Wisconsin Aluminum Foundry Co., Manitowac, Wis.; 3rd Award, Edwin D. Lasecki, Zandt Brass Foundry, Inc., Seattle.



STEEL MOLDING—1st Award, Donald A. Sprague, Columbia Steel Casting Co., Portland, Ore.; 2nd Award, Donald L. Mallder, Rock Island Arsenal, Rock Island, Ill.; 3rd Award, Siegfried G. Mueller, Electrocast Steel Foundry Co., Chicago.

Name A. L. Hunt AFS President

Albert L. Hunt, AFS President 1961-62 has been in the foundry business most of his life and served as an AFS Director 1951-1954.

He is a past chairman of the AFS St. Louis Chapter and was chairman of the Foundry Educational Foundation's industrial advisory committee for the University School of Mines & Metallurgy, Rolla, Mo.

He began his career as a draftsman for the Mississippi Valley Structural Steel Co., St. Louis in 1928, later working in a similar capacity for St. Louis Frog & Switch Co. and the city of St. Louis. He joined American Brake Shoe Co., National Bearing Div., St. Louis in 1936 and was successively machine shop superintendent, sales engineer, plant superintendent, works engineer, and vice-president of operations.

After 24 years of service with American Brake Shoe Co., Hunt in 1939 joined Superior Foundry Co., Cleveland, as executive vice-president.

Select Wagner Vice-President

John R. Wagner, elected as AFS Vice-President, has been associated with the foundry industry and Wagner Castings Co. since serving in the U. S. Marine Corps 1918-19. He started as a timekeeper in 1919 at Wagner Castings Co., Decatur, Ill., serving in this capacity for three years. From 1922 to 1926 he served as the foundry's production manager becoming vice-president in 1926 and serving in that capacity until 1934. Since 1934 he has been president.

Wagner is a past president of the Malleable Founders Society and for 12 years served as a director of that association. He has been a speaker before the annual meetings of M.F.S. and spoken before AFS Chapters.

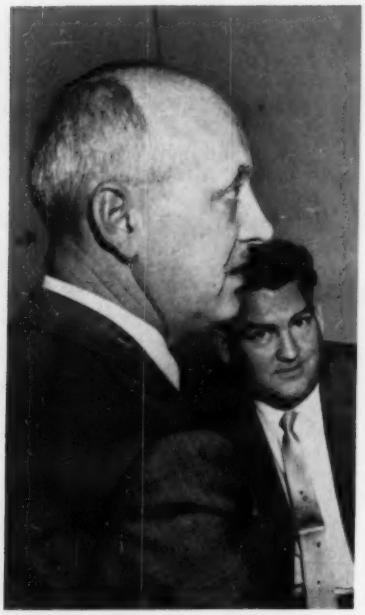
Mail Floor Plan for 1962 Show

Floor plans for the AFS 66th Annual Castings Congress & Exposition have been mailed to foundry equipment manufacturers and suppliers. The Congress & Exposition will be held in conjunction with the 29th International Foundry Congress in Cobo Hall, Detroit, May 7-11, 1962.

Industry Leadership

. . . men who made news at the AFS Castings Congress

President Norman Dunbeck cites the stepped-up tempo of AFS technical activities fostered during his term of office.



New technology of furfural binders is brought into practical focus by W. H. Buell at the Sand Shop Course.

AFS Technical Director S. C. Massari and General Manager W. W. Maloney check the progress of the 65th annual congress as it unfolds in San Francisco.

New career opportunities in metalcasting are explored by AFS leaders for the benefit of newspaper and magazine reporters.

Aerospace progress is spotlighted by five leading castings designers in a Light Metals Round Table Luncheon. Left to right are W. A. Bailey, A. H. Peterson, T. E. Piper, J. H. Rizley, and R. A. Zuech.

Knight LETTER

SEVENTH IN A SERIES

To: Foundry Management

Subject: Meeting Competition

The future holds many opportunities and problems for the foundry industry. New technology and new metallurgy offer greater penetration of old markets and development of applications in new markets by providing a finished component to perform the desired function at lowest cost.

To take full advantage of these opportunities all foundrymen should—

1. Improve sales engineering to perform a service and minimize selling metal at so much per pound.
2. Fully utilize present manpower and facilities.
3. Develop plans to modernize facilities and methods, streamline organization and procedures.

Knight organization engineers are specialists in foundry problems, having successfully completed more than 1000 varied foundry assignments in 21 countries. Key men of the Knight organization have 10 to 30, or more, years of successful experience in foundry management, production, plant layout or equipment.

Call on Knight specialists to audit your operations and assist you to plan for the future, meet competition and maintain adequate profitability.

KNIGHT SERVICES INCLUDE:

Foundry Engineering • Construction Management • Modernization • Mechanization • Automation • Survey of Facilities • Materials Handling • Methods • Industrial Engineering • Wage Incentives • Cost Control • Standard Costs • Flexible Budgeting • Production Control • Organization • Marketing

EVIDENCE OF EXPERIENCE

Lester B. Knight & Associates, Inc.

Management Consultants, Industrial and Plant Engineers

Member of the Association of Consulting Management Engineers, Inc.

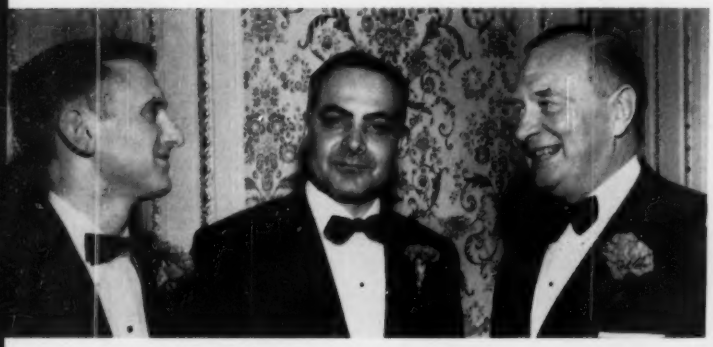
549 W. Randolph Street, Chicago 6, Illinois

New York Office—Lester B. Knight & Associates, Inc., Management Consultants, 500 Fifth Ave., New York 36
20111 James Couzens Highway, Detroit 35, Michigan
Knight Engineering A.G. (Zug), Zurich Branch, Dreikönigstrasse 21, Zurich, Switzerland
Lester B. Knight & Associates, G.M.B.H., Berliner Allee 47, Düsseldorf, Germany

Industry Recognition

. . . for outstanding contributions to metalcasting

Honor winners of Service Citations and Awards of Scientific Merit. Recipients include, left to right, K. M. Smith, A. D. Barczak, J. Toth (Board of Awards Chairman Collins Carter) H. J. Weber, H. E. Henderson and T. R. Schroeder.



Coveted Gold Medal winners are M. C. Flemings, Jr. and W. S. Pellini, shown here with Collins Carter.

Hoyt Lecturer Jack Caine took castings designers and producers to task for their timidity.

Leroy Grotto, left, wins the Gray Iron Division Award for the best paper. He's congratulated by Harvey Henderson.

Youth had its day when the Apprentice Contest winners were honored. Three young men, William Mulvey, Kenneth McGarr, and James Arnold, traveled to San Francisco to receive their awards.

Birth of a Gray Iron Casting—No. 2

SELECTION OF COAL

Coal selection, washing and blending are elementary but vitally important steps in the production of foundry coke. Today, modern mining equipment and efficient cleaning methods enable the coke producer to utilize highest quality coals for coking purposes.

From the rich deposits in Kentucky and West Virginia, Pittsburgh Coke & Chemical Company utilizes coals containing a high percentage of low volatile Pocahontas to produce Neville Foundry Coke. This strong, dense, uniform coke; controlled through every step of production, has more fixed carbon, less ash and sulphur content.

The use of Neville Foundry Coke produces better, cleaner, more fluid iron—the type required by the foundry to produce the wide variety of fine gray castings so important to this nation's industry.

COKE & IRON DIVISION

PITTSBURGH

COKE & CHEMICAL CO.

GRANT BUILDING PITTSBURGH 19, PA.

Neville Pig Iron and Neville Coke for the Foundry Trade

Circle No. 179, Pages 127-128

Spotlight on New Technology

. . . new fiber for metalcasting

Technical Director Massari briefs J. G. Mezoff, Light Metals Session Chairman, on the meeting format for the technical sessions.

Gray iron technology in action—new direct reduction process is described by T. E. Ban.

Electric melting to improve quality of bronze alloys is extolled by R. V. Barone.

Isolating good and bad effects of trace elements was the key effort of George Sandoz at the Naval Research Laboratory.

Three authors—G. W. Stahl, C. H. Schweinsberg, and F. S. Ross, compare notes before heading into their die casting session. Growth in the segment of the industry stimulated extensive interest in their field.

Calcined fluid coke—carbon sand—is one new molding medium attracting attention. E. G. Gentry, right, emphasized many of the uses for the medium in detail.

San Francisco's air pollution problems are being brought under control by a new program, says B. Linsky, Bay Area Pollution Control Officer.

The way Ford Motor Co. makes cores by the new hot core box process revealed by E. E. Harkess.

Achievements in new technology are cited at the annual Steel Round Table Luncheon. Division award for the best paper went to co-authors P. R. Gouwens, J. T. Berry, and T. Watmough. W. A. Koppi acknowledges their award.

For the Ladies

. . . fashions and frills on the distaff side

The Occidental influence was not overlooked in styles paraded for the ladies of AFS at the annual luncheon and fashion show.

More than 200 wives traveled to San Francisco for the 65th Castings Congress. The official AFS Tea presented a "get acquainted" opportunity. Mrs. Albert Hunt, honorary hostess, takes her turn at pouring.

AFS President Dunbeck receives the "VIP" treatment when he drops in at the Ladies Tea. Mrs. Edward Claar, Mrs. Collins Carter and Mrs. Dunbeck attend to his nourishment.

For the benefit of those metalcasters who toiled with the technology of their trade—here's what you missed on Tuesday afternoon.

. . . THE ONE HOLLOW SHELL CORE UNIT THAT OFFERS MORE

More productivity, more flexibility, more real value for your equipment dollar—that's the B&P Cormatic. The SF6-BA Automatic Hollow Shell Core Machine eliminates guess work. Precision, foundry-proved timers control each phase of the cycle and a single push of a button actuates the entire cycle. In addition to built-in skill, B&P engineers have provided the highest B.T.U. output and precision heat control for fastest, most uniform curing. All Cormatics, of course, feature famous B&P ruggedness and dependability.

Three automatic Cormatics are easily attended by one man and provide up to 240 cycles per hour for outstanding productivity at lowest cost. Even three different size cores with different production time cycles can be produced at top efficiency. No necessity to slow the whole operation because one core requires a longer curing cycle. Box changes can be made on one unit without affecting the high productivity of the other units.

The SF6-B, a low cost, easy to operate Cormatic with operator-actuated valves is available where the higher productivity of the automatic Cormatic is not required.

Circle 161 on Pages 127, 128

SF6-BA CORMATIC

BEARDSLEY & PIPER

Div. of Pettibone Mulliken Corp.

2424 N. Cicero Ave., Chicago 39, Illinois

L. H. Durdin Heads T&RI Trustees

Former AFS President L. H. Durdin, Dixie Bronze Co., Birmingham, Ala., has been named as chairman of the AFS Training & Research Institute Trustees. He succeeds Hyman Bornstein who had served as trustee chairman since the inception of the Institute in 1956.

J. A. Gitzen, Delta Oil Products, Milwaukee, has been named as a T&RI Trustee succeeding I. R. Wagner, one of the original trustees.

L. H. Durdin

J. A. Gitzen

During the first quarter of 1961, enrollment in T&RI courses has shown a considerable increase. In the seven courses presented from January to April 1, the average enrollment per course was 38, compared to a full-year average of 24 in 1960 and 27 in 1959.

Largest enrollment of the year to date has been *Shell Molds and Cores* held during March in Birmingham, Ala. The course was co-sponsored by the AFS Birmingham Chapter and represents the greatest number of students at any program sponsored by T&RI and chapter.

Four regional courses have been given during the first three months, the most during a similar period since the program was started.

Figures show that during the first quarter of 1961 that nearly 85 per cent of the students represented foundries, an all-time high. Satisfaction with the program is demonstrated by the fact that more than half of the companies sent students to a second course.

Kiesler, Seelbach to Represent AFS

A. J. Kiesler and Walter L. Seelbach will act as AFS Official Delegates at the 29th International Foundry Congress to be held June 18-24 at Vienna, Austria.

Kiesler, General Electric Research Laboratories, Schenectady, N. Y., will present his AFS Official Exchange Paper, "Desulfurization of Carbon Steel to Extra Low Limits in the Basic Electric Furnace."

Seelbach, president, Superior Foundry, Inc., Cleveland, served as AFS President 1951-52.

The International Foundry Congress is sponsored by the International Committee of Foundry Technical Associations of which AFS is the sole member. The Association of Austrian Foundry Experts will be hosts to the international meeting.

Twenty-eight technical papers will be presented by outstanding foundrymen from 17 countries including two by Russians. In addition to the technical sessions, meetings will be held by international committees on foundry dictionary, foundry coke, foundry clays, testing of CO_2 materials, malleable iron, hot cracking, and foundry properties of metals.

Other highlights include an extensive plant visitation program, a ladies program, and post congress tours.

The Organization of the International Committee of Foundry Technical Associations for 1961 is composed of: President, Prof. J. S. Darnis, Spain; Vice-President, Robert Doat, Belgium; Treasurer, M. Vuilleumier, Switzerland; and Secretary, Dr. P. W. Muller, Switzerland.

The International is being organized by Verein Osterreichischer Giessereifachleute on behalf of the International Committee of Foundry Technical Organizations.

Penn Regional June 22-24

Problems encountered by operating foundrymen will be discussed at the 3rd Biennial Foundry Conference to be held June 22-24 at University Park, Pa.

Subjects will be divided into sand, gray and malleable, nonferrous, and steel sessions. Each will be by a coordinator. Stewart Wick, New Jersey Silica Sand Co., Millville, N. J., is the sand coordinator; J. Douglas James, Urick Foundry Co., Erie, Pa., is the gray and malleable iron coordinator; James D. Wilson, Bronze Die Casting Co., Pittsburgh, Pa., is the non-ferrous coordinator; and R. W. Zillman, Pittsburgh Steel Foundry Corp., East Pittsburgh, Pa., is the steel coordinator.

T. E. Egan, Cooper-Bessemer Corp., Grove City, Pa., is conference chairman; J. T. Gresh, American Brake Shoe Co., New York, is conference vice-chairman. Program coordinators are Egan and W. P. Winter, Pennsylvania State University.

The conference outline:

THURSDAY, JUNE 22

8:30 Registration, lobby, Hetzel Union Bldg.

12:15 Luncheon, Hetzel Union Bldg. Ballroom. Speaker, C. S. Wyand, vice-president for development, Pennsylvania State University.

Afternoon Conference Sessions

6:00 Picnic and Mixer, Hecla Park

FRIDAY, JUNE 23

All Day Conference Sessions

SATURDAY, JUNE 24

Morning Conference Sessions

Chapter Officers Meet June 15-16

Officials from the 47 AFS chapters will meet June 15-16 at Des Plaines, Ill., and Chicago, for the annual Chapter Officers Conference.

The meeting gives new chapter officers a better understanding of Society operations. Workshop sessions permit a review by department heads and include a question and answer period.

One day will be spent at the AFS Headquarters in Des Plaines, Ill. The workshop system will be used to explain various Society functions such as MODERN CASTINGS, the AFS Training & Research Institute, technical activities, membership, publications, AFS-sponsored activities, and the Safety, Hygiene & Air Pollution Control Program.

The second day will take place at the LaSalle Hotel in Chicago. These sessions will be devoted to other Society and Chapter functions.

Technical Council Meets on June 6

Technical activities of the Society will be formulated at the annual Technical Council meeting to be held June 6 at the Sheraton Hotel, Chicago.

All Technical Division Chairmen and Vice-Chairmen of the General Interest Committees are invited to attend. A review of the activities of each group will be made as well as a discussion of future plans.

"F" Nickel shot gives gray iron castings the extra life your customers want

When you add Inco "F"* Nickel shot to a ladle of molten gray iron, you greatly improve your control over the metal structure and add appreciably to the service life of the castings.

For example, you can boost tensile and compressive strengths, rigidity, and the response of the part to heat treatment. "F" Nickel increases the resistance of the castings to wear, to mechanical and thermal shock, to high temperatures. It promotes development of a uniform density across thick and thin sections. It even improves the chill control in castings.

As you will quickly recognize, many of these effects do more than add a service-life extra. They also help you overcome many of the factors that make for rejects and increase your costs.

How can "F" Nickel control so many factors?

"F" Nickel was specially developed by Inco for ladle addition to gray iron. It provides Nickel (92%) and silicon (5.5%) in a desirable balance and in forms that go into solution in the melt at a low 2300°F. Nickel works together with the carbon to help you establish desirable pearlitic matrices with excellent dispersion of properly sized graphite flakes.

For easy ladle addition, Inco's distributors supply Inco "F" Nickel shot in 500-pound drums.

For more information on the improvement of gray iron with Inco "F" Nickel, write for our useful, 32-page booklet, "Engineering Properties and Applications of NICKEL CAST IRONS."

*Registered trademark

THE INTERNATIONAL NICKEL COMPANY, INC.
67 Wall Street New York 5, N. Y.

INCO NICKEL

NICKEL MAKES CASTINGS PERFORM BETTER LONGER

Circle No. 163, Pages 127-128

CHAPTER NEWS

Install Newest Chapter at Ryerson Institute

RYERSON STUDENT CHAPTER—AFS General Manager Wm. W. Maloney hands the symbolic rattle to Chairman Richard Simons. Others are Secretary August Kloppenburg, Vice-Chairman Karl Voitel; and Industrial Advisor W. H. L. Bryce, Grinnell Co. of Canada, Ltd.

Canada's first AFS Student Chapter has been installed at Ryerson Institute of Technology, Toronto, Ont. AFS officials, 22 student members, Ryerson faculty, and officers and directors of the AFS Ontario Chapter participated.

AFS General Manager Wm. W. Maloney presented Student Chapter Chairman Richard Simons with the cast iron rattle traditionally given to the Society's newest member.

Prior to installation ceremonies, visitors inspected Ryerson's new facilities as a technical institute and expressed confidence in the school's interest in cast metals instruction. Principal H. H. Kerr and Vice-Principal J. W. Hazelton emphasized the value of close cooperation with Canadian industry.

Maynard D. Bleaken, Union Carbide Canada, headed a nine-man team of officers and directors from the Ontario Chapter. Regional Vice-President A. J. Moore, Canadian Bronze, Ltd., Montreal, addressed the meeting stressing the importance of cast metals to all industry. Other speakers were E. R. Jones, head, Metallurgical Technology Dept., and R. S. M. Gray, Canadian Westinghouse, Ltd., chairman-elect of the Ontario Chapter.

H. Howard, instructor in metallurgical technology, is the faculty advisor to the 14th AFS Student Chapter. Industrial advisor of the Ontario Chapter is W. H. L. Bryce, Grinnell of Canada, with direct liaison to the student group assigned to Alec Bain, Canada Iron Foundries.

Officers of the Student Chapter in addition to Chairman Simons are Karl Voitel, vice-chairman; and August Kloppenburg, secretary-treasurer.

RYERSON STUDENT CHAPTER—Attending the installation ceremonies of the newest chapter were: back row—E. R. Jones, head, Ryerson Dept. of Metallurgy; A. Bain, Canada Iron Foundries; J. W. Hazelton, Ryerson Vice-Principal; V. Furlong, Ontario Chapter Membership Chairman; H. Howard, Student Chapter Faculty Advisor; K. B. McCullogh, Union Carbide Canada; W. H. L. Bryce, Grinnell Co. of Canada; H. H. Kerr, Ryerson Principal; and AFS Regional Vice-President A. J. Moore.

Front row: Ontario Chapter Chairman M. D. Bleaken; P. Walters, Union Carbide Canada; Ontario Chapter Treasurer S. E. Robinson; R. Gray, Canadian Westinghouse Co., Ltd.; AFS General Manager Wm. W. Maloney; A. Stewart and K. Senior, both of Canadian General Electric Co., Ltd.

Tri-State Chapter

Steel Casting Design

Design and use of steel castings was discussed by a four-man panel with Robert W. Trimble, Bethlehem Supply Co. acting as moderator. Panelists were: Clint Cross, W. C. Norris Co.; George McNinch, Sinclair Oil & Gas Co.; J. S. Eberle, Missouri Steel Castings Co.; and C. M. Diel, Acme Foundry & Machine Co.—by Bobby Bell

Utah Chapter

Names Officers, Directors

Officers and directors have been named for the coming technical year. They are:

Chairman—B. R. MacKay, Lake Metals Co., Salt Lake City.

1st-Vice-Chairman—J. W. Nielsen, Columbia Geneva Steel Div., United States Steel Corp., Provo, Utah.

2nd Vice-Chairman—J. N. Carter, American Foundry & Machine Co., Div., Eimco Corp., Salt Lake City.

Secretary—W. W. Brown, Pacific States Cast Iron Pipe Co., Provo, Utah.

Treasurer—F. T. Hafen, Pacific States Cast Iron Pipe Co., Provo, Utah.

New directors are retiring Chairman E. H. Backman, Backman Foundry Co., and E. W. Hunziker, Columbia Geneva Steel Div.

AFS National Director A. E. Falk, Centrifugal Casting Co., Long Beach, Calif., discussed centrifugal castings in an illustrated talk.—by P. A. Sawyer

Rochester Chapter

New Core Developments

Careful examination of present plant facilities and capabilities must be studied before adopting new core-making techniques, warned Victor Rowell in discussing the latest developments. He stated that the new binders are not a cure all for every application and that the addition costs make investigations essential.

The newest developments in core binders are air setting and require no heat for curing, stated Rowell. He described the binder as a furfural alcohol. He pointed out that another binder consisting of a formaldehyde alcohol is now being used for blowing into heated boxes. This binder is good for thin sections only. It cures rapidly but only to a depth of 2-1/2 to 3 inches. The formaldehyde alcohol binder produces a core that can be handled at room temperature, has high hot strength, and low strength at shakeout temperatures.—by Robert Dill

CENTRAL INDIANA—Attending a recent meeting were George Dehn, Wheelabrator Corp., Mishawaka, Ind.; Norbert Blaski, Chrysler Corp., Indianapolis; and Charles Keller, Chrysler Corp., Kokomo, Ind.—by W. R. Patrick

ONTARIO—Canada's position in the world economic picture was presented by G. O. Loach, Metals & Carbon Div., Union Carbide Canada, Ltd., right. Others are J. A. Wotherspoon, J. A. Wotherspoon & Son, Ltd., and AFS National Director D. E. Webster.—by P. B. Walters

WESTERN NEW YORK—Problems of safety, hygiene, and air pollution in foundries was discussed by H. J. Weber, AFS. Others are Chapter Chairman Ed O'Connell and former AFS National Director W. D. Dunn. —by Don Kreuder

NORTHWESTERN PENNSYLVANIA—Harry W. Dietert discussing recent developments in sand control and technology.—by Walter Napp

SOUTHERN TIER—New officers include: L. C. Wallitt, Jr., treasurer; M. E. Brady, secretary; Milford Paris, vice-chairman; and W. G. Parker, chairman.—by Fran Troy

MICHIANA—Past Chairman were honored recently at National Officers night attended on far right by AFS National Director T. T. Lloyd and AFS Secretary A. B. Sinnett. Others are James Maggart, Howard Vorhees, Vern Spears, Roy Payne, Floyd Crowley, Bob Hull, Lew Peew, Fred Davis, Stan Kriecheski, Bill Johnson, Andy Peterson.—Joseph Lazzara

Circle No. 164, Pages 127-128 ➡

alloy briquets for the cupola charge

Each different Ohio Ferro-Alloys briquet for the iron foundry has a distinct shape and color. Costly errors in adding silicon, manganese or chromium to the charge are avoided.

Silicon briquets are GRAY and **cylindrical** in two sizes: either 1 pound or 2 pounds of contained silicon. The 2-pound size is also available in a brick shape. Manganese briquets (shown above) are RED and are **oblong** in shape. Silicomanganese is YELLOW and **square**. Chromium briquets are GREEN and **hexagonal** in shape.

For detailed information, write for **Ferro-Alloy Briquets for The Iron Foundry.** It's free, and there's no obligation.

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QUAD CITY—Rock Island Arsenal apprentices won two places in the AFS National Apprentice Contest. Robert Swenson, vocational supervision, Rock Island Arsenal, and Vernon Meyer, foundry foreman, Rock Island Arsenal are shown at the extremes. In the center are Donald Mallder, apprentice molder, 2nd place in national steel casting competition, and Stanley Purvis, apprentice molder, 3rd place in national gray iron casting competition.—by Leo E. Osbourne

WESTERN NEW YORK—Attending the annual ladies night and dinner dance were Arnold Martin, Bill Abergast, Mrs. A. Martin, Mrs. Don Kreuder and Mrs. W. Abergast.

CHICAGO—Clyde Sanders, American Colloid Co., Skokie, Ill., left, spoke on the foundry of the future. On right is Bud Eidman, Blaw-Knox Co., East Chicago, Ind., Technical Chairman.—by George DiSylvestro

WESTERN NEW YORK—Remember when it was tough to get a membership committee? No problem here. Walter Mundy, American Radiator & Standard Sanitary Corp., right, appears to be the magnet. On left, Miss Jane MacTaggart, Samuel Greenfield Co.—by Don Kreuder

CENTRAL ILLINOIS—Attending a recent meeting are former AFS President F. W. Shipley, left, and M. J. Gregory. Gregory designed, built, and managed the Caterpillar Tractor foundry at Peoria, Ill., and was succeeded by Shipley after retiring.—by Charles W. Search

NORTHEASTERN OHIO—Fred Pfarr, Hines Flask Co., entertainment chairman, and Spence Tuck, Chapter Director, Forest City Foundries Co.—by Sterling Farmer

GRAPHITE

FLUXING TUBES ?

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Circle No. 165, Pages 127-128

CENTRAL NEW York—Don J. Merwin, left, former chapter chairman was honored recently for his contributions to the chapter. William Dunn, right, assistant to the president, Oberdorfer Foundries, Inc., presided.—by A. F. Izzo

Central New York Chapter

Honor Don Merwin

Former Chapter Chairman Don J. Merwin was honored at a recent meeting for his contributions to the chapter and foundry industry. The program was arranged by a group of former chairmen.

Merwin, a graduate of Warren (Ohio) Business College has served as superintendent for the Malleable Div., Warren Tool Co., Meadville Malleable Iron Co., Frazer & Jones Co. and later sales manager and assistant superintendent for Eastern Malleable Iron Co. and is currently vice-president Orinskany Malleable Iron Co.

At the technical session, O. V. Warner Debovoise-Anderson Co., spoke on "Practical Hints for Cupola Operation."—by A. F. Izzo

ST. LOUIS—Sand control problems and possible solutions were discussed by J. R. Young, Cadillac Div., General Motors Corp. Sand practices used by Cadillac as well as possible future sand control measures were covered.—by W. E. Fecht

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Iowa Malleable Iron Co. in Fairfield, Iowa, faced the problem of finding a faster method of handling synthetic sand to and from the re-conditioning process. Speeding-up the turn-around of this sand would provide a sizeable increase in molding production.

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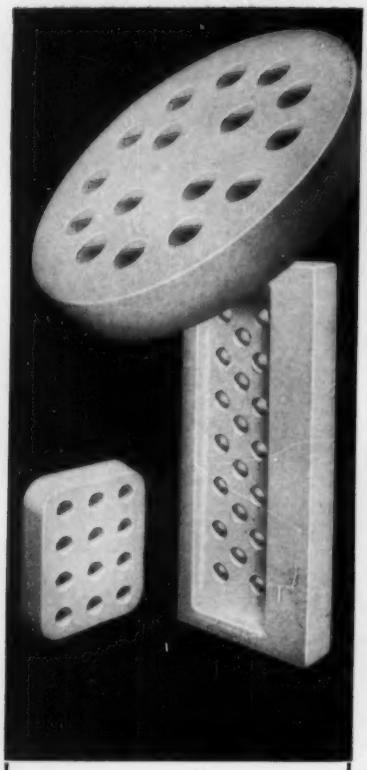
Circle No. 166, Pages 127-128



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Circle No. 167, Pages 127-128

METROPOLITAN—Quality Castings through proper end gating was the subject of a panel discussion. Members were: Armand Cretazzo, Bendix Foundry; R. B. Fischer, Ingersoll-Rand Co.; John Anspach, Foundry Management & Development Corp.; and G. M. Poirier, General Electric Co.—by Walter Napp

DETROIT—Participants in the chapter's annual apprentice contest. Alan E. Larson, Progress Pattern Co., right, first row, won 3rd place in the AFS National Competition in wood patternmaking. James S. Arnold, Progress Pattern Co., 3rd row, second from left, won first place national honors in metal patternmaking.—by Walter Ring

NORTHERN ILLINOIS-SOUTHERN WISCONSIN—Apprentice winners: wood patternmaking, Gerald Lesperance, Zickert Pattern Co.; metal patternmaking, Don Smith, National Grey Iron Foundry Div., Moline Malleable Iron Co.; and metal casting, Clint Pearson, Belvidere Community High School.

TRI-STATE CHAPTER—George McNinch, right, Sinclair Oil & Gas Co., right, panel member shown with moderator Robert W. Trimble, Bethlehem Supply Co., and Chapter Chairman Harry J. Ferlin, Tulsa Pattern & Mfg. Co. Sign promotes September Missouri Valley Regional Conference.—by Bobby Bell

CHICAGO—University of Illinois student Tom Stephen receives F.E.F. scholarship award from Edward Walsh, director of the Foundry Educational Foundation.—by George DiSylvestro

CANTON—Sand control technology was explained by George Vingas, Magnet Cove Barium Corp., Arlington Heights, Ill.—by Charles Stroop.

Detroit Chapter

Foundry Maintenance

An organized program of preventive maintenance through inspection, check lists, and machine history lists, are essential for an effective program, stated speaker G. S. Moxlow, Ford Motor & Co.

How the program was installed and the benefits realized were pointed out in an illustrated talk. He warned that the human element still exists and that an effective training program must be initiated.—by J. H. Barron, Jr.

John R. Hood, 13, and his winning entry in the Kent County (Mich.) science fair. He is the son of John Hood, general manager, Grand Rapids Foundry, Grand Rapids, Mich., and a student at Riverside Junior High School.

NORTHEASTERN OHIO—Motivation for quality was explained at a recent meeting by J. M. Juran, New York. Others are George Purdy, Aluminum Co. of America, technical chairman; Jim Oesterling, chairman, Cleveland section, American Society for Quality Control; Dr. Lloyd Nelson, General Electric Co.; Sam Troxel, Ohio Bell; Ted Ursu, Thompson Ramo Woolridge; and AFS Regional Vice-President D. L. Colwell.—by Harold Wheeler

DETROIT CHAPTER—Progress Pattern Co., Detroit, led the way in the AFS National Apprentice Contest. Alan E. Larson, left, placed third in the national wood patternmaking competition; Ronald Czinki won seventh place in the national wood patternmaking competition; James S. Arnold was the national winner in the metal patternmaking. On far right is W. G. Shaw, president, Progress Pattern Co.—by Walter Ring

SPOTLIGHT ON
RUSSIAN CASTINGS PRODUCTION

Cover to cover translation of Liteinoe Proizvodstvo.

Liteinoe Proizvodstvo is the leading Russian periodical devoted to the foundry industry. It deals with all aspects of iron, steel and non-ferrous castings production in Russia, from raw materials to finished products, including their behavior. As a service to the foundry industry on both sides of the Atlantic, the British Cast Iron Research Association is publishing a cover to cover translation of this important journal each month. If you wish to keep up to date on current Russian practice—and their fresh approach to day-to-day problems, new techniques and metallurgical investigations are of interest to every go-ahead foundryman—a year's subscription is a worthwhile investment.

FEATURED ARTICLES

- A precision casting foundry
- Scrap reduction
- High-capacity cupola blowers
- Gating systems for pressure die-castings
- Cupola operation with natural gas partly replacing coke
- Non-metallic inclusions in malleable iron.
- Stresses due to the strength of cores
- All Union conference on production of magnesium-treated high-duty irons
- The Moscow Foundrymen's Conference

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Circle No. 172, Pages 127-128 MC 2

Northern Illinois-Southern Wisconsin Chapter

Tips on Apprentice Contest

Apprentice competition is one of the highlights for many of the AFS Chapters. The Northern Illinois-Southern Wisconsin Chapter is one of these. Each year a large program is held and competition is extremely keen. The first three winners in each of the divisions receive cash awards of $25, $15, and $10.

Many of the chapter's procedures could be adopted by other groups for building apprentice contest programs.

Initial work on the contest started in December, 1960. Some of the decisions made at this time were:

Draft initial letter to companies having potential contestants.

Draft and set dates for reminder correspondence.

Decide on the cities from which the judges would be selected.

Select closing date for contestants to enter and the closing date for the local contest. Experience has shown that the time of giving drawings and the closing date should be about six weeks.

Select the place and date for judging. Judging should run from 1:30 pm and continue through the evening. Allow ample room for judging and show patterns against a covered table to improve selection.

Invite judges and contestants to be guests at the awards dinner.

The awards dinner is planned to increase the knowledge of the apprentice contestants. Patterns are selected at random and constructive criticism given on each. Patterns are also analyzed as to cost and this report is given. However, this not considered in the judging.

Chapter winners from the Beloit, Rockford, Belvidere area were:

Wood Patternmaking—Gerald Lesperance, Zickert Pattern Co., Beloit; Duane Matchett, Atlas Pattern Co., Beloit; Dave Darling, Beloit Pattern Co., South Beloit.

Metal Patternmaking—Don Smith, National Grey Iron Foundry Div., Moline Malleable Iron Co., Belvidere; George Kelly, also of National Grey Iron; Eugene Sand, Universal Pattern Works.

Metal Casting—Clint Pearson, Belvidere Community High School; William Horner, National Grey Iron; John Rivers, Belvidere Community High School.

NORTHERN ILLINOIS-SOUTHERN WISCONSIN —Don Mason, Atlas Pattern Co. with other judges begin work on evaluating entries in the annual contest.

NORTHERN ILLINOIS-SOUTHERN WISCONSIN —Bernard Lowenstein, Rockford Aluminum Foundry and Ken Wendorf, Beloit Foundry, judge casting entries.

NORTHEASTERN OHIO—Chapter Chairman Norm Strickney, Sand Products Corp., right, and Chapter 2nd Vice-Chairman Ed Texler, Osborn Mfg. Co.—by Sterling Farmer

Rochester Chapter

Hears Ferrous Foundry Talk

Use of calcium carbide cupola injections for increasing the tapping temperature and reducing the amount of coke was described by Ralph Clark, Union Carbide Metals Co., Div. Union Carbide Corp. The process is one of the latest in cupola operating techniques.

The demand for higher quality iron at the turn of the century has brought about increased use of ferro-alloys, Clark pointed out. Approximately 100,000 tons of ferro-silicon are used yearly by the foundry industry. It is manufactured either by the blast furnace or by the submerged arc furnace. In the latter, a reducing agent, usually carbon, and an ore are put into the furnace resulting in CO gas and the ferro-alloys.

Other subjects covered by Clark were the electrolytic process for producing manganese and chromium and a new technique for using nitrogen gas to introduce carbon.—by Robert Dill.

Piedmont Chapter

Small Foundry Mechanization

A full schedule of foundry subjects were sponsored recently by the chapter.

At the regular chapter meeting C. V. Nass, Beardsley & Piper Div., Pettibone Mulliken Corp., discussed small foundries and the future. He emphasized how mechanization was the answer to increasing production. Previously the chapter had conducted a foundry seminar designed to train foundry foremen and others in key technical or operating positions. Thirteen subjects were covered at the seminar.—by Larson E. Wile

C. V. Nass

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Circle No. 169, Pages 127-128

Foundry Trade News

International Foundry Supply Co. . . . Reading, Pa., has been appointed a sales agent for F.E. North America, Ltd., in four eastern states. International Foundry Supply Co. recently conducted an open house to show their line of equipment.

C. O. Bartlett & Snow Co. . . . Cleveland, has been purchased by Pacific Foundry & Metallurgy Co., San Francisco. The new corporation will be known as Bartlett-Snow-Pacific. The San Francisco and Cleveland companies will operate as separate divisions of Bartlett-Snow-Pacific.

Case Institute of Technology . . . has named the $2.7 million metallurgy building nearing completion in honor of Charles M. White, Case Trustee and former chairman of the board and chief executive officer of Republic Steel Corp.

National Engineering Co. . . . Chicago, has purchased the Hydro-Blast Div. of Guardite Co., Div. American Marietta Co., located in Wheeling, Ill. Hydro-Blast manufactures blast-type cleaning equipment and a wet system for reclaiming foundry sand.

Whiting Corp. . . . Harvey, Ill., has consolidated its three foundry product groups and its metallurgical consulting service into a Metallurgical Equipment Div. Groups and their managers are: cupolas and accessories, C. McGlone; furnaces, ladles and pulverizers, R. A. Muhleman; hydro-arc electric furnaces, C. W. Vokac; metallurgical consulting service, W. R. Jaeschke.

Kaiser Aluminum & Chemical Corp. . . . Mead, Wash., reduction plant has installed new facilities for refining super purity aluminum, increasing its capacity for producing 99.99 plus pure aluminum by 55 per cent.

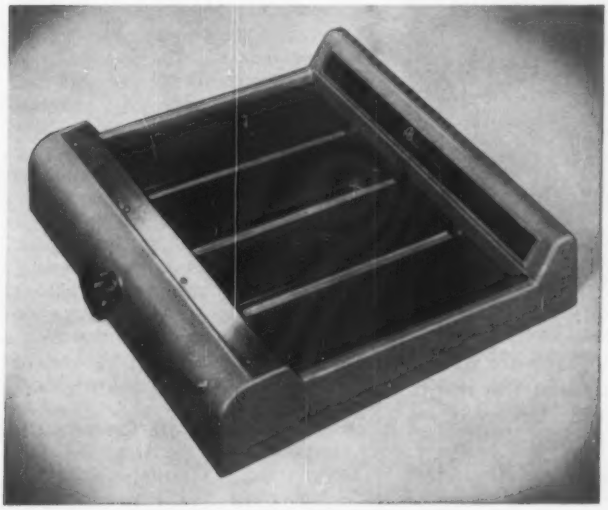
Dan Pendergast . . . manufacturers' agent and secretary of the AFS New Modern Equipment Co. line in the England Chapter, has added the Modern Equipment Co. line in the New England territory.

LFM Mfg. Co. . . . Atchison, Kans., subsidiary of Rockwell Mfg. Co., has reorganized its sales operations to strengthen sales in the foundry industry. Appointments are: W. H. Nass, sales order department; C. A. Trapp, service engineer; John Moore, sales correspondent for Kansas City area. Nass is responsible for liaison between sales, engineering and production, Trapp customer casting problems, and Moore, general sales service.

Manley Sand Co. . . . Rockton, Ill., has been acquired by American-Marietta Co. and will be operated as a division. Headquarters remain in Rockton under direction of the former management.

Frederic B. Stevens, Inc. . . . has moved its Buffalo, N. Y. plant and warehouse from 93 Stone St. to 597 Northland Ave. The new buildings contain more than 25,000 square feet of warehousing space.

International Nickel Co. of Canada . . . has started production of refined



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nickel at the world's second largest nickel operation 51 months after plans for the project in northern Manitoba were announced. The plan will increase Inco's annual nickel-producing capacity by more than 75,000,000 pounds.

International Minerals & Chemical Corp. . . . which co-sponsored a foundry marketing conference with Walter E. Gerlinger, Inc., this year in Milwaukee, plans to expand the program. Conferences of the same type will be introduced into other areas. A follow-up schedule of concentrated and more detailed workshop meetings will be held in general locations covered by the first conference. The initial meeting was attended by 125 representatives from 45 foundries in central and southern Wisconsin.

Harry W. Dietert Co. . . . Detroit, is adding a 5000 square foot addition for research, development, engineering, and laboratory departments.

Olin Mathieson Chemical Corp. . . . has announced a commercially practical way of making aluminum from common clay. The aluminum sulfate produced by Olin's acid process can be processed into alumina, the basic raw material for the manufacture of aluminum. The process is said to open the possibility of placing a complete aluminum plant on one site where coal for electric power is cheap, since the shales associated with most coal could be an excellent source of alumina.

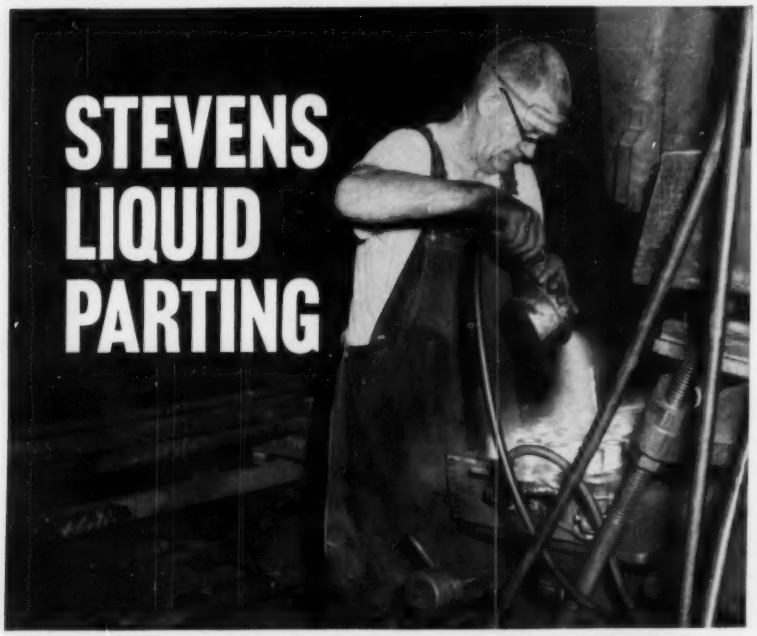
Foundry Educational Foundation . . . D. H. Morgan, Director of College Relations, Dow Chemical Co., has been named as president. Other officers are: vice-president, C. F. Strom, vice-president, Griffin Wheel Co.; secretary, Anton Dorfmueller, Jr., assistant general manager, Federal Foundry Supply Div., Archer-Daniels-Midland Co.; treasurer, W. G. Gude, editor, Foundry magazine; executive director, E. J. Walsh. AFS trustees to F.E.F. are W. C. Jeffery, product development manager, McWane Cast Iron Pipe Co. and N. N. Amrhein, president, Federal Malleable Co.

Last year there were 236 F.E.F. students studying metallurgical engineering, 164 in mechanical engineering, 57 in industrial engineering, 18 in electrical engineering, and 38 in various other groupings. In addition to the 513 undergraduate students, 33 graduate students participated.

American Steel Foundries . . . has reduced the prices on some of the major cast steel components for the railroad industry. The reductions include lowering by 3 per cent side frames and bolsters, both essential components of freight car trucks.

New Jersey Zinc Co. . . . has opened competition in its annual die casting contest. Awards of $500 will go to both the individual in the die casting company and the individual in the customer's organization who in the opinion of their respective employers have contributed most to the successful design and production of the casting. Competition closes Aug. 1.

National Open Hearth Conference . . . sponsored by the Iron and Steel Div., American Institute of Mining, Metallurgical, and Petroleum Engineers, included sessions on cold metal and basic foundries. Speakers and subjects included F. H. Hohn, Scullin Steel Co., St. Louis, "Methods for Evaluating Refractories;" E. W. Ganslein, Buckeye Steel Casting Co., Columbus, Ohio, "Use of the Natural Gas-Oxygen Burner in All-Cold Metal Open Hearth Furnaces;" and D. R. Haines, General Steel Castings Corp., Eddystone, Pa., "Improved Chromium Recovery and Control in the Basic Open Hearth."



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Circle No. 171, Pages 127-128

Let's Get Personal . . .

Earl M. Strick . . . Finishing Dept., Erie Malleable Iron Co., Erie, Pa., has completed 50 years in the foundry industry—46 years with Erie Malleable and 4 years with Zurn Mfg. Co. He was co-organizer of the AFS Northwestern Pennsylvania Chapter and its second chairman. He was also secretary, treasurer, and educational chairman. Strick also served as National Chairman of the Youth Encouragement Committee of AFS. Among his educational activities he produced the slide film program "A Career in Metals." He has been a speaker at several AFS national conventions as well as AFS chapters on the subject of foundry educational programs and the finishing of malleable iron castings. In 1954 he was given an AFS Honorary Life Membership for his national and chapter educational activities.

Norman A. Grieg . . . is general manager, Centre Foundry & Machine Co., Wheeling, W. Va.

W. H. Johnson . . . formerly with Battelle Memorial Institute, is now technical director, Centrifugal Casting Div., Shenango Furnace Co., Dover, Ohio.

Aldo J. Sartor . . . sales engineer, Pangborn Corp., has been transferred to the west coast office, Pasadena, Calif.

Harold E. Imes . . . is president of Semet-Solvay Div., Allied Chemical Corp., New York, succeeding **A. E. Scherm** who is retiring after 20 years as president of the division.

Donald S. Smith . . . is the new plant manager, Aluminum and Magnesium Div., A. C. Williams Co., Ravenna, Ohio. **Robert C. Boehm** is now quality control manager and chief metallurgist of the division.

Robert S. Moore . . . is sales representative for Chas. Taylor Sons Co., Cincinnati, covering accounts in Ohio, Pennsylvania, and New York.

Watson B. Wilkins . . . is now sales manager, Northern Bronze Corp., Philadelphia.

Edward F. Koglin . . . appointed to newly created post of director of development, G. E. Smith, Inc., Pittsburgh, Pa.

R. G. Martinek . . . named as product sales manager of Hevi-Duty Electric Co.'s five furnace and oven product lines. **C. A. Newton** is product manager of the light industrial furnace line. Hevi Duty, Watertown, Wis., is a division of Basic Products Corp., Milwaukee.

I. H. Dennen . . . has returned to Beardsley & Piper Div., Pettibone Mulliken Corp., Chicago, as assistant general manager. **John R. Noreen** has been appointed as manager of purchasing.

John V. Patton . . . has been named plant manager and director of purchases for W. W. Sly Mfg. Co., Cleveland.

Arne E. Swanson . . . named assistant plant manager, Doehler-Jarvis Div., National Lead Co., Batavia, N. Y., plant. **Clyde A. Wilcox** is works manager.

Alexander P. Raeburn . . . is secretary-treasurer, American Refractories & Crucible Corp., North Haven, Conn. Other appointments: **Charles H. Pierce,** director of sales; **Denys R. Rosling,** heads engineering sales-service department.

Ivor Thompson . . . is vice-president, Cerro Sales Corp., subsidiary of Cerro Corp., and is responsible for marketing non-ferrous metals produced by a subsidiary operating in Peru.

Robert J. Anderson . . . consulting metallurgist and metallurgical adviser in patent cases, Fort Worth, Texas, has resumed practice.

John G. Mezoff . . . heads a technical service and development group organized by Dow Chemical Co.'s new Metals Dept. The group has been established to support any Dow program for the sale of primary metal. Initially, the emphasis will be on magnesium die casting, especially for automotive applications.

S. Donald Sanders . . . is manager, Cleveland Works, National Malleable & Steel Castings Co.

Gerald W. Jensen . . . named president, Denver Fire Clay Co., Denver, succeeding **Richard C. Shepard** who continues as chairman of the board.

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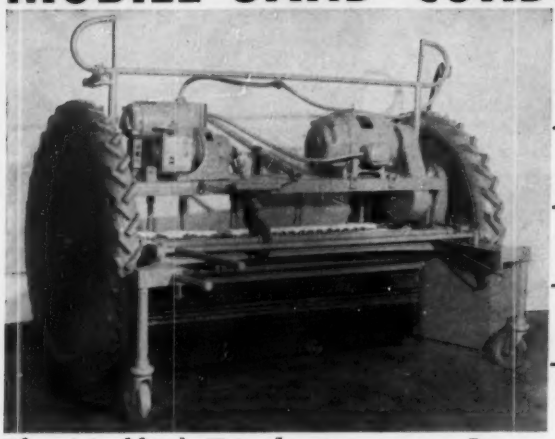
MOBILE SAND CONDITIONER



BRUSH LENGTH		
50"	60"	70"
OVERALL WIDTH		
70"	80"	90"
THROAT WIDTH		
53"	63"	73"
THROAT DEPTH		
23"	23"	23"

The Moulders' Friend goes anywhere in the shop under its own power, and thoroughly conditions two tons of sand in one minute. All it requires is a few pennies per ton for operation, and the attention of one man. Its rotary brush quickly mixes and aerates the sand—mixes, moistens and screens it so rapidly and economically that no foundry with sand on the floor can afford to be without one. See one in operation.

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Dallas City, Illinois
Circle No. 173, Pages 127-128

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Circle No. 174, Pages 127-128

Also elected as officers are: **James T. Rutherford,** vice-president of manufacturing; **Paul J. Thiel,** vice-president of sales.

J. J. Offutt . . . elected to board of directors, A. P. Green Fire Brick Co., Mexico, Mo. Offutt, vice-president and general manager, fills the unexpired term of **W. H. Peterson, Sr.,** resigned.

Emil Romans . . . is now foundry manager and district sales manager, Canton Malleable Iron Co., Canton, Ohio. **Al Wells,** district sales manager, becomes assistant to the general manager.

John F. Torley . . . elected president and general manager, Dayton Malleable Iron Co., replacing **Anthony Haswell,** elected chairman of the board.

Anthony L. Ascik . . . elected vice-president, Tennessee Products & Chemical Corp., Nashville, Tenn., and heads the alloy and metal operations.

G. F. Kolle . . . is assistant general manager and treasurer, Inductotherm Linemelt, subsidiary of Inductotherm Corp., Delanco, N. J.

E. J. Jeter . . . AFS National Director, promoted to general manufacturing manager, Engine & Foundry Div., Ford Motor Co., Dearborn. **H. C. Grant** replaces Jeter as manufacturing manager-foundries. **William E. Goudey** becomes manager, Dearborn Iron & Specialty Foundries.

H. P. Eells, Jr. . . . named to newly created office of chairman and chief executive officer, Basic, Inc., Cleveland. **Warner B. Bishop** succeeds Eels as president and named as a member of the board of directors with **Matthew J. Ludwig,** vice-president-controller. **Thomas D. Hess,** named as assistant district manager, sales staff, Cleveland district.

Robert L. Crooks . . . joins Bohn Aluminum & Brass Corp., Detroit, as sales representative assigned to the Chicago district office.

William A. Risher . . . named administrative assistant, a newly created post at Williams & Co., Pittsburgh, Pa.

O. Jay Myers . . . is now acting as liaison between Reichhold Chemicals, Inc., and Reichhold Chemicals (Canada) Ltd., as well as serving as vice-president, Foundry Div., Reichhold Chemicals, Inc.

Future Meetings and Exhibits

June 6 . . Technical Council Meeting, American Foundrymen's Society, Sherman Hotel, Chicago.

June 8-9 . . Malleable Founders Society, Annual Meeting. The Broadmoor, Colorado Springs, Colo.

June 11-15 . . 54th Annual Air Pollution Control Association Meeting, Hotel Commodore, New York City.

June 15-16 . . AFS Chapter Officers Conference, AFS Headquarters, Des Plaines, Ill., and La Salle Hotel, Chicago.

June 18-20 . . Alloy Casting Institute, Annual Meeting, Hot Springs, Va.

June 18-24 . . 28th International Foundry Congress, Vienna Imperial Castle, Vienna, Austria.

June 20-21 . . Investment Casting Institute Technical Course, Case Institute of Technology, Cleveland, Ohio.

June 22-24 . . AFS Penn State Regional Foundry Conference. Penn State University, University Park, Pa.

June 25-30 . . American Society for Testing Materials, Annual Meeting. Chalfonte Haddon Hall, Atlantic City, N. J.

July 18-20 . . Western Plant Maintenance & Engineering Show, Pan Pacific Auditorium, Los Angeles.

Aug. 28-Sept. 1 . . American Society of Mechanical Engineers, International Heat Transfer Conference, University of Colorado Campus, Boulder, Colorado.

Sept. 3-8 . . American Chemical Society, Fall Meeting. Chicago.

Sept. 20-23 . . American Ceramic Society, Enamel Division, French Lick-Sheraton Hotel, French Lick, Ind.

Sept. 21-22 . . Missouri Valley Regional Conference, Rolla School of Mines, Rolla, Missouri.

Sept. 22-23 . . East Coast Regional Foundry Conference, Statler-Hilton Hotel, New York.

Sept. 24-26 . . Steel Founders' Society of America, Fall Meeting. The Homestead, Hot Springs, Va.

Oct. 5-6 . . Ohio Regional Conference. Netherland Hilton Hotel, Cincinnati.

Oct. 9-11 . . National Association of Corrosion Engineers, Symposium & "Exhibit in Miniature", Chase Park Plaza Hotel, St. Louis, Mo.

Oct. 13-14 . . New England Foundry Conference, Massachusetts Institute of Technology, Cambridge, Mass.

Oct. 16-21 . . National Industrial Sand Association, Semi-Annual Meeting. The Greenbrier, White Sulphur Springs, W. Va.

Oct. 19-20 . . Michigan Regional Foundry Conference. Michigan State University, East Lansing, Mich.

Oct. 26-27 . . Purdue Metals Castings Conference, Purdue University, Lafayette, Ind.

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SUPPLIERS' DIRECTORY
Modern Castings Advertisers
1961

A handy alphabetical reference guide to products, processes, and services offered by leading manufacturers in the metalcasting industry. All of the companies listed here have displayed their products on the pages of MODERN CASTINGS *during 1961. Manufacturers' names and addresses can be found at the end of this section.*

ABRASIVES, BLASTING

Carborundum Co.
Hickman, Williams & Co.
Metal Blast, Inc.
National Engineering Co.
National Metal Abrasive Co.
Pangborn Corp.
Pennsylvania Glass Sand Corp.
Alexander Saunders & Co.
Walker Peenimpac Machine Mfg. Div. Walker Pump Co.
Wedron Silica Co.
Wheelabrator Corp.

ALUMINUM ALLOYS

Alloys & Chemicals Corp.
American Smelting & Refining Co.
Olin Mathieson Chemical Corp.
Reynolds Metal Co.
Vanadium Corp. of America
WaiMet Alloys Co.

BORON ALLOYS

Vanadium Corp. of America

BOTTOM AND PRESSER BOARDS

Adams Co.

BRONZE ALLOYS

American Smelting & Refining Co.

CALCIUM ALLOYS

Union Carbide Metals Co., Div. Union Carbide Corp.

CALCIUM-SILICON

Ohio Ferro-Alloys Corp.
Union Carbide Metals Co., Div. Union Carbide Corp.

CARBON & GRAPHITE PRODUCTS

National Carbon Co., Div. Union Carbide Corp.

CARBON SAND

Great Lakes Carbon Co.
Humble Oil & Co.

CHILLS, CHAPLETS, NAILS

Archer-Daniels-Midland Co. Federal Foundry Supply Div.
Fanner Mfg. Co.
Standard Horse Nail Corp.

CHROMIUM ALLOYS

Ohio Ferro-Alloys Corp.
Union Carbide Metals Co., Div. Union Carbide Corp.
Vanadium Corp. of America

CLEANING ROOM EQUIPMENT & SUPPLIES

Pangborn Corp.
Walker Peenimpac Machine Mfg. Div. Walker Pump Co.
Wheelabrator Corp.
Whiting Corp.

COLUMBIUM ALLOYS

Vanadium Corp. of America

COKE

Alabama By-Products Corp.
Alan Wood Steel Co.
DeBardeleben Coal Corp.
Hickman, Williams & Co.
Koppers Company, Inc. Gas & Coke Div.
Pickands Mather & Co.
Pittsburgh Coke & Chemical Co.
Semet-Solvay Div., Allied Chemical & Dye Corp.

CONSULTING SERVICES

Carver Foundry Products
Chas C. Kawin Co.
Lester B. Knight & Associates, Inc.
D. C. Latella & Associates, Inc.
Modern Equipment Co.
National Engineering Co.
Stahl Specialty Co.
Whiting Corp.

CONTAINERS, PALLETS & BOXES

Wirebound Box Manufacturers Association

CONVEYORS

National Engineering Co.
Simplicity Engineering Co.
Syntron Co.

CORE & MOLD BLOWERS & SHOOTERS

Beardsley & Piper Div. of Pettibone Mulliken Corp.
Carver Foundry Products
Shalco Div., National Acme Co.

CORE PASTES

Archer-Daniels-Midland Co. Federal Foundry Supply Div.
Frederic B. Stevens, Inc.

CORE PLATES

Adams Co.
Shalco Div., National Acme Co.

CO_2 EQUIPMENT

Carver Foundry Products
General Dynamics, Liquid Carbonic Div.

CO_2 GAS

General Dynamics Corp., Liquid Carbonic Div.

CRUCIBLES

American Refractories & Crucible Corp.
Brown Boveri Corp.
Crucible Manufacturers' Assn.
Great Lakes Carbon Corp.
National Carbon Co., Div. Union Carbide Corp.
Alexander Saunders Co.
Frederic B. Stevens, Inc.

CUPOLAS

Great Lakes Carbon Corp.
Modern Equipment Co.
Whiting Corp.

CUPOLA ACCESSORIES

Modern Equipment Co.
National Carbon Co., Div. Union Carbide Corp.
Whiting Corp.

DEOXIDIZERS, DEGASSERS, GRAIN REFINERS

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Foseco, Inc.

DUST & FUME CONTROL EQUIPMENT

Pangborn Corp.
Walker Peenimpac Machine Mfg. Div. Walker Pump Co.
Wheelabrator Corp.

EXOTHERMICS

American Colloid Co.
Foseco, Inc.
Ohio Ferro-Alloys Corp.
Frederic B. Stevens, Inc.
Union Carbide Metals Co., Div. Union Carbide Corp.
Vanadium Corp. of America

FERRO-ALLOYS

Hickman, Williams & Co.
Keokuk Electro-Metals Co. Div. of Vanadium Corp. of Amrica
Molybdenum Corp. of America
Ohio Ferro-Alloys Corp.
Pickands Mather & Co.
Union Carbide Metals Co., Div. Union Carbide Corp.
Vanadium Corp. of America
WaiMet Alloys Co.

FILM, FILM PROCESSING, DARK-ROOM EQUIPMENT

Eastman Kodak Co.

FLASKS & JACKETS

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American Foundry Flask Co.
Archer-Daniels-Midland Co. Federal Foundry Supply Div.
Hickman, Williams & Co.
Hines Flask Co.
Sterling National Industries

FLUXES

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American Smelting & Refining Co.
Cleveland Flux Co.
Foseco, Inc.
Hickman, Williams & Co.
Frederic B. Stevens, Inc.
Superflux Mfg. Co.

FLUXING TUBES

Great Lakes Carbon Corp.
National Carbon Co., Div. Union Carbide Corp.

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Hickman, Williams & Co.
Frederic B. Stevens, Inc.
Whiting Corp.

FURNACES

Ajax Magnethermic Corp.
Brown Boveri Corp.
Hevi-Duty Electric Co.
Lectromelt Furnace Div. McGraw-Edison Co.
Lindberg Engineering Co.
Whiting Corp.

GREEN SAND ADDITIVES

American Colloid Co.
Archer-Daniels-Midland Co. Federal Foundry Supply Div.
Bariod Chemicals, Inc. Div. of National Lead Co.
Hickman, Williams & Co.
Reichhold Chemicals, Inc.
Frederic B. Stevens, Inc.

GRINDERS

Grinding & Polishing Machinery Corp.

GRINDERS, PNEUMATIC

Airetool Mfg. Co.

HARDNESS TESTING EQUIPMENT

Harry W. Dietert Co.

INOCULANTS, GRAPHITIZING

Union Carbide Metal Co., Div. Union Carbide Corp.

INVESTMENT CASTING EQUIPMENT & SUPPLIES

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Alexander Saunders & Co.

LABORATORY TESTING EQUIPMENT & SUPPLIES

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Buehler, Ltd.
Harry W. Dietert Co.
Carver Foundry Products
Great Lakes Carbon Corp.
Lindberg Engineering Co.
Pasadena Hydraulics, Inc.

LADLES

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Modern Equipment Co.
National Carbon Co., Div. Union Carbide Corp.
Whiting Corp.

LADLES & SUPPLIES

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Industrial Equipment Co.
Modern Equipment Co.
National Carbon Co., Div. Union Carbide Corp.
Whiting Corp.

MAGNESIUM ALLOYS

Ohio Ferro-Alloys Corp.

MAGNETIC SEPARATORS

Royer Foundry & Machine Co.

MAGNETS

Ohio Electric Mfg. Co.

MANGANESE ALLOYS

Ohio Ferro-Alloys Corp.
Union Carbide Metals Co., Div. Union Carbide Corp.
Vanadium Corp. of America

MANHOLE FRAMES, ADJUSTABLE

Adjust-A-Frame Corp.

MATERIAL HANDLING EQUIPMENT

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Modern Equipment Co.
National Engineering Co.
Ohio Elect Mfg. Co.
Roura Iron Works, Inc.
Royer Foundry & Machine Co.
Simplicity Engineering Co.

Syntron Co.
Whirl-Air-Flow Corp.
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Molybdenum Corp. of America
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NICKEL ALLOYS

American Smelting & Refining Co.
International Nickel Co., Inc.
WaiMet Alloys Co.

OVENS

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Hevi-Duty Electric Co.
Lindberg Engineering Co.
Whiting Corp.

PARTING AGENTS

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Humble Oil & Refining Co.
Reichhold Chemicals, Inc.
Shalco Div., National Acme Co.
Frederic B. Stevens, Inc.

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Scientific Cast Products

PATTERN SUPPLIES

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PERMANENT MOLD DIES

Stahl Specialty Co.
Permanent Mold Die Co.

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Hanna Furnace Div., National Steel Corp.
Hickman, Williams & Co.
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Pittsburgh Coke & Chemical Co.
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PULVERIZERS

Wheelabrator Corp.

PYROMETERS

Pyrometer Instrument Co., Inc.
L. H. Marshall Co.
Alexander Saunders Co.
Whiting Corp.

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Cerium Metals & Alloys Div. Ronson Metals Corp.
Vitro Chemical Co.

REFRACTORIES, GATING & RISERING

American Refractories & Crucible Corp.
Harbison-Walker Refractories Co.
Louthan Mfg. Co., Div. Ferro Corp.
National Carbon Co., Div. Union Carbide Corp.
Alexander Saunders & Co., Inc.
Universal Clay Products Co.

REFRACTORY LINING MATERIALS

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American Refractories & Crucible Corp.
Carborundum Co.
Great Lakes Carbon Corp.
Harbison-Walker Refractories Co.
Hickman, Williams & Co.
National Carbon Co.
Div. Union Carbide Corp.
Superflux Mfg. Co.
Chas. Taylor & Sons, subsidiary National Lead Co.

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American Refractories & Crucible Corp.
Carborundum Co.
Great Lakes Carbon Corp.
Harbison-Walker Refractories Co.
Humble Oil & Refining Co.
National Carbon Co., Div. Union Carbide Corp.
Alexander Saunders & Co.
Chas. Taylor & Sons, subsidiary National Lead Co.

RESINS, EPOXY

Furane Plastics, Inc.

SAFETY EQUIPMENT

Alexander Saunders & Co.

SAND

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American Colloid Co.
Hickman, Williams & Co.
Pennsylvania Glass Sand Corp.
Wedron Silica Co.

SAND ADDITIVES

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Archer-Daniels-Midland Co. Federal Foundry Supply Div.
Corn Products Sales Co.
Hickman, Williams & Co.
Humble Oil & Refining Co.
Reichhold Chemicals, Inc.
Shalco Div., National Acme Co.
Frederic B. Stevens, Inc.

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Magnet Cove Barium Corp.
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Hercules Powder Co.
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SAND BINDERS—SELF-CURING

American Colloid Co.

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Berkshire Chemicals, Inc.
Humble Oil & Refining Co.
Reichhold Chemicals, Inc.
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SAND BINDERS—SODIUM SILICATE

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Keokuk Electro-Metals Co. Div. of Vanadium Corp. of America
Ohio Ferro-Alloys Corp.
Union Carbide Metals Co., Div. Union Carbide Corp.
Vanadium Corp. of America

SILVERY PIG IRON

Hanna Furnace Div., National Steel Co.
Hickman, Williams & Co.
Keokuk Electro-Metals Co. Div. of Vanadium Corp. of America
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Alexander Saunders & Co., Inc.
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Pangborn Corp.
WaiMet Alloys Co.

WELDING EQUIPMENT & SUPPLIES

General Dynamics Corp., Liquid Carbonic Div.
International Nickel Co.
National Carbon Co., Div. Union Carbide Corp.
Speer Carbon Co.

ZIRCON

Berkshire Chemicals, Inc.
Metal & Thermit Corp.
Chas. Taylor & Sons, subsidiary National Lead Co.
WaiMet Alloys Co.

ZIRCONIUM ALLOYS

Union Carbide Metals Co., Div. Union Carbide Corp.

Advertisers' Addresses

Listed here are key manufacturers in the foundry supply industry. All of these companies have offered their products, supplies and services to foundrymen on the pages of MODERN CASTINGS *during 1961.*

ADAMS CO., P.O. Box 268, Dubuque, Iowa.
ADJUST-A-FRAME CORP., 903 Leesburg Pike, Falls Church, Va.
AIRETOOL MFG. CO., 302 S. Center St., Springfield, Ohio.
AJAX MAGNETHERMIC CORP., 3990 Simon Rd., Youngstown 7, Ohio.
ALABAMA BY-PRODUCTS CORP., P.O. Box 354, Birmingham 2, Ala.
ALAN WOOD STEEL CO., Conshohocken, Pa.
ALLOYS & CHEMICALS CORP., 4365 Bradley Road, Cleveland 9.
AMERICAN COLLOID CO., 5100 Suffield Court, Skokie, Ill.
AMERICAN FOUNDRY FLASK CO., 2745 Southwest Blvd., Kansas City 8, Mo.
AMERICAN REFRACTORIES & CRUCIBLE CORP., North Haven, Conn.

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AMERICAN SMELTING & REFINING CO., 120 Broadway, New York.

ARCHER-DANIELS-MIDLAND CO., Federal Foundry Supply Div., 2191 W. 110th St., Cleveland 2.

ATLAS TESTING LABORATORIES, INC., 1225 East 63rd St., Los Angeles 1.

BAROID CHEMICALS, INC., Div. National Lead Co., 1809 South Coast Life Bldg., Houston 1, Texas.

BEARDSLEY & PIPER DIV., Pettibone-Mulliken Corp., 2424 N. Cicero Ave., Chicago 39.

BERKSHIRE CHEMICALS, INC., 630 Third Ave., New York 17.

BESTWALL GYPSUM CO., 120 E. Lancaster Ave., Ardmore, Pa.

BRITISH CAST IRON RESEARCH ASSOCIATION, Bordesley Hall, Alvechurch, Birmingham, England.

BROWN BOVERI CORP., 19 Rector St., New York.

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CAMPBELL-HAUSFELD CO., Harrison, Ohio.

CARBORUNDUM CO., Buffalo Ave., Niagara Falls, N. Y.

CARVER FOUNDRY PRODUCTS, 1056 Hershey Ave., Muscatine, Iowa.

CERIUM METALS & ALLOYS DIV., Ronson Metals Corp., 55 Manufacturers' Place, Newark 5, N. J.

CLEARFIELD MACHINE CO., P.O. Box 249, Clearfield, Pa.

CLEVELAND FLUX CO., 1026-40 Main Ave., N.W., Cleveland 13.

CORN PRODUCTS SALES CO., 10 East 56th St., New York 22.

CRUCIBLE MANUFACTURERS' ASSOCIATION, 11 W. 42nd St., New York 36.

DeBARDELEBEN COAL CORP., 2201 First Ave., North, Birmingham 3, Ala.

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HARRY W. DIETERT CO., 9330 Roselawn Ave., Detroit 4.

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EASTMAN KODAK CO., X-Ray Div., 343 State St., Rochester 4, N. Y.

FANNER MFG. CO., Brookside Park, Cleveland 9.

FOSECO, INC., P.O. Box 8728, Cleveland 35.

FURANE PLASTICS, INC., 4516 Brazil St., Los Angeles 39.

GENERAL DYNAMICS CORP., Liquid Carbonic Div., 135 S. LaSalle St., Chicago 3.

GENERAL FOODS CORP., Corn Mill Div., Kankakee, Ill.

GREAT LAKES CARBON CORP., 18 E. 48th St., New York 17.

GRINDING & POLISHING MACHINERY CORP., 2530 Winthrop Ave., Indianapolis 5, Ind.

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HARBISON-WALKER REFRACTORIES CO., 307 Fifth Ave., Pittsburgh 22.

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Build an idea file for improvement and profit. Circle numbers on literature request card, page 127, for manufacturers' publications.

Thermosetting sand binder . . . for production of cold-coated sands is suitable for dump-box and blowing operations. Cold-coating is accomplished by the powder-alcohol process giving free-flowing, non-blocking, sand with good storage properties. Leaflet outlines properties. Union Carbide Plastics Co., Div. Union Carbide Corp.

Circle No. 10, Pages 127-128

Coreless induction furnace . . . 60 cycle, reportedly gives high efficiency in iron and steel melting with minimum loss of power due to radiation, convection, or conduction. Four-page folder gives operating principles and performance data. Detroit Electric Furnace Div., Kuhlman Electric Co.

Circle No. 11, Pages 127-128

Molten steel deoxidizing . . . products are specially designed castings of metallurgical grades of aluminum for plunging. Four-page booklet includes other deoxidizing agents. Brown Aluminum & Chemical Co., subsidiary of Brown Fintube Co.

Circle No. 12, Pages 127-128

Sand coating machine . . . fully automatic, is completely self-contained. Has batch capacity of 150 lb or 5 tons per 8 hour day. Illustrated booklet fully describes machine including operating notes, and dimensions. Shalco Div., National Acme Co.

Circle No. 13, Pages 127-128

Heat-proof protective coatings . . . reportedly adds years to normal life of equipment subjected to extreme heat and corrosive conditions. Brochure describes four types to meet various temperature conditions. Markal Co.

Circle No. 14, Pages 127-128

Basic brick products . . . line for non-ferrous metal furnaces, and electric furnaces are described in data sheets which include physical properties, advantages, and how to use. H. K. Porter Co.

Circle No. 15, Pages 127-128

Remove grease-caked dirt . . . from floors in one operation with self-propelled industrial floor machine. Four-page bulletin diagrams operation, pictures accessories, shows uses, and gives specifications. G. H. Tennant Co.

Circle No. 16, Pages 127-128

High purity aluminum alloys . . . brochure compares characteristics for three alloys detailing the purity, ductility, strength, and castability as well as charting aging practices for one. Kaiser Aluminum & Chemical Sales, Inc.

Circle No. 17, Pages 127-128

Carbon-graphite materials . . . 8-page engineering guide gives grade recommendations for seals and sliding surfaces for a wide range of liquids and gases at operating temperatures up to and above the 500 F. range. National Carbon Co. Div., Union Carbide Corp.

Circle No. 18, Pages 127-128

Silicone mold release agents . . . for shell molding process give reliable, clean release of cured shell from patterns. Breakdown products of silicones are small in volume, lightly adherent, and easily cleaned from patterns. Silicone Products Dept., General Electric Co.

Circle No. 19, Pages 127-128

Load cell systems . . . overcome problems of shock-loading and/or continuous vibration. Operates without friction and eliminates maintenance. Martin-Decker Corp.

Circle No. 20, Pages 127-128

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Circle No. 176, Pages 127-128

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to compute correct sizes for economy and maximum feeding efficiency. Foseco, Inc.

Circle No. 21, Pages 127-128

Castable refractories . . . booklet describes full range of products for use in furnaces ranging in temperatures from 700 F. to 3500 F. and with characteristics designed to meet special conditions. Kaiser Refractories & Chemicals Div., Kaiser Aluminum & Chemical Sales, Inc.

Circle No. 22, Pages 127-128

Testing machine brochure . . . describes complete line including units for testing hardness, ductility, tensile, compression, transverse, hydrostatic and pneumatic, and special testing machines. Steel City Testing Machines, Inc.

Circle No. 23, Pages 127-128

Heavy-duty cleaning jobs . . . are handled economically with barrel blasting. Five sizes available from 15 to 102-cubic foot capacities. Sixteen-page catalog outlines features and applications.—Pangborn Corp.

Circle No. 24, Pages 127-128

Roller hearth furnace . . . for heat treating processes provides full anneal of steel castings. May be used for stress relief anneal. Bulletin outlines specifications. Industrial Heating Dept., General Electric Co.

Circle No. 25, Pages 127-128

Mullite refractories . . . bulletin describes applications, and chemical and physical properties. Chas. Taylor Sons Co.

Circle No. 26, Pages 127-128

Aluminum patternmaking alloy . . . reportedly provides effective control during casting by minimizing variations in shrinkage. Composition also improves machinability. Federated Metals Div., American Smelting & Refining Co.

Circle No. 27, Pages 127-128

Gas-fired infra-red burners . . . perform low-temperature process heating including die and mold heating, drying, and curing. Dimensional drawings and detailed specifications are presented for burners and required accessories. Also complete selection and sizing information for burners and accessories. Eclipse Fuel Engineering Co.

Circle No. 28, Pages 127-128

Troller conveyors . . . for small, relatively simple jobs to complex systems are detailed on book which includes complete information for designing system with appropriate components, supports, superstructures, and guards. Also has tables of materials, dimensions, specifications of components, drawings, and cutaway photographs. Link-Belt Co.

Circle No. 29, Pages 127-128

Simplifying pipe measurement . . . "How to Measure and Relate Pipe, Tubing and Hose Sizes," is the title of 16-page booklet which supplies standard methods of measurements, discussing both similarities and differences involved in measuring various fittings and fluid-carrying lines in order to arrive at satisfactory fluid line installations. Aeroquip Corp.

Circle No. 30, Pages 127-128

Barrel finishing . . . contents of 96-page booklet include descriptions of the various barrel finishing processes, recommendations of various abrasive shapes and sizes for applications in which they are best suited, case histories of actual uses, description of all types of finishing equipment available, discussion on compounds and their effects, and a section devoted to practical suggestions on operating procedures. Norton Co.

Circle No. 31, Pages 127-128

Positioning devices . . . catalog describes all of company's tools, including new series of clamps, as well as complete line of machine vises, rotary tables, and other work-holding devices for metal-working industry. Universal Vise & Tool Co.

Circle No. 32, Pages 127-128

Mechanizing research . . . brochure discusses A.S.M. new electronic system of searching metallurgical and related literature for specific information on subjects. Discusses mechanized way to reduce research costs and increase accuracy, speed, and effectiveness. American Society for Metals.

Circle No. 33, Pages 127-128

Ramming mix . . . descriptive folder covering application of a high magnesia ramming mix for use in open hearth steel furnaces. Highly refractory material is made from periclase grains of 94% to 96% magnesia content bonded together in furnace bottoms at relatively low temperatures. High strength of periclase bond is maintained by a solid phase recrystallization. Kaiser Refractories & Chemical Div., Kaiser Aluminum & Chemical Corp.

Circle No. 34, Pages 127-128

New Products and Processes

What's new in foundry methods and equipment? Summaries of many are presented below. Circle corresponding number on free postcard, page 127. Mail it to us; we'll do the rest.

Automatic Coreblowing Machine Ideal for Furan Resin Binders

Automatic core blowing machine for hot-box process stresses design simplification and operating efficiency. Unit is reportedly ideal for all furan resin sand binders with production of hot-box process cores ranging up to 140 per hour using a 15 second cure time. Production can be increased with reduced cure time and multiple cavity boxes. Single station design means entire process is done on one machine. Pick-off unit delivers finished cores to operator reducing handling. Other features are thermostatic temperature control of both halves of core box, automatic sequence control of blow, cure and strip, and dual machine operation. Beardsley & Piper Div., Pettibone Mulliken Corp.

Circle No. 1, Pages 127-128

Epoxy Resin Cuts Production Cost on Pattern Duplication

Epoxy resins cuts corebox duplication 75 to 80 per cent over duplication in metal. After one hour of curing, epoxy resin coat is ready for lamination which depends upon depth of cavity. This is followed by overnight curing and filling of corebox cavity with cast plastic. After curing and cooling to room temperature, corebox is completed and ready for use. Ren Plastics, Inc.

Circle No. 2, Pages 127-128

Controller Adjusts Moisture for Constant Moldability

Moldability controller automatically adjusts moisture as sand composition fluctuates so that sand of a constant moldability is delivered to molding station. Quality of molds is improved since sand is prepared not necessarily to a constant moisture percentage, but to a constant ramming sand.

Controller automatically adds ingredients such as slurry, water, and/or bonds to the sand in the mixer until a predetermined moldability of the sand is secured. As return or new sand composition changes, the controller automatically maintains a constant moldability or workability of the sand. Unit uses single principle of sand screening. Harry W. Dietert Co.

Circle No. 3, Pages 127-128

New Carbon Sand Improves Finish Cuts Veining and Penetration

New carbon sand, consisting of round, solid grains of hard carbon, differs in grain structure from all other forms of carbon. Said to be readily moldable for molds, cores, and shells, replacing sands partially or entirely. Thermal expansion is said to be 1/10th that of silica sand, AFS No. 70, four-sieve analysis. Smoother casting finish, less veining, scabbing, and penetration are claimed. Humble Oil & Refining Co.

Circle No. 4, Pages 127-128

New Ceramic Choke Bushing Reduces Metal Turbulence

Ceramic choke bushing throttles sprue diameters and reduces outlet diameters of ells and tees. It utilizes a tapered entry side to eliminate metal turbulence and aspiration of air. The male and female offsets assure positive fitting with other refractory gating components. Bushing aids will not spall or erode at temperatures to 3250 F., thus eliminating sand inclusions and resulting chipping and welding time. Components are available for gating systems up to 3-inch ID as standard, larger sizes available on order. Universal Clay Products Co.

Circle No. 5, Pages 127-128

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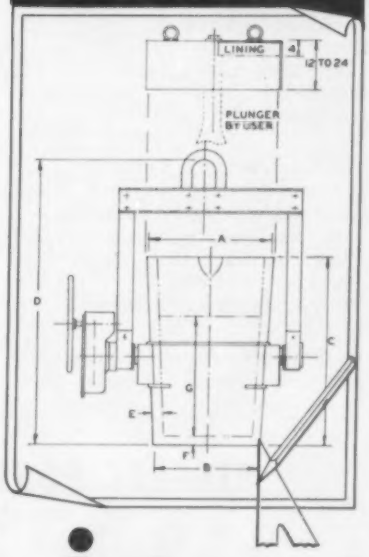

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Circle No. 178, Pages 127-128

New Books

X-Ray Metallography . . . A. Taylor. 993 pages. John Wiley & Sons, Inc., 440 Park Avenue South, New York 16, N. Y. 1960. Applications of x-ray techniques to the study of metals and their alloys is the main theme. The author also includes, for completeness, reference to analogous neutron and electron diffraction procedures. Along with the basic theory, a detailed description is given of the apparatus and experimental procedures required in the solution of problems. The book is practical as well as theoretical, containing tables useful to the x-ray worker, and references that act as a guide to the literature for those who wish to advance their studies further. Topics covered in the volume include: production of x-rays, x-ray absorption and both x-ray and neutron radiography; crystal symmetry and the atomic arrangements in crystals; crystal structures of the metallic elements and factors leading to polymorphic forms; experimental methods of obtaining the many kinds of diffraction patterns, and determination of the atomic arrangements in real crystals with the aid of these patterns; application of x-ray procedures to the nature of alloys; crystal chemistry of alloys, and intermetallic compounds; and internal stresses in metals.

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SALES REPRESENTATIVE TO CALL ON IRON & STEEL FOUNDRIES IN OHIO AND PENNSYLVANIA. Iron or steel foundry background essential, preferably in sand control or pattern shop or both. Sales experience not essential, but preferred. Good future for the right man. Salary and incentive plan commensurate with ability. Replies held in strictest confidence. **Reply Box F-106 H, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOUNDRY CHEMIST

Experienced Resin Chemist wanted by leading producer of foundry core binders. Must be college graduate with Chemistry major. Practical foundry experience desirable but not essential. Excellent compensation and fringe benefits for right man. Send resume to: **Box F-109 H, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

MOLDING FOREMAN—Experienced, aggressive man required as foreman over Mechanized production green sand units. Gray Iron Shop, located in North Jersey. Send complete resume and salary requirements to **Box F-104 H, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

GRAY IRON FOUNDRY SUPERVISOR
$8,000 to $10,000
Assured future with foundry where competence is rewarded with advancement. Company pays fee. Contact Robert L. Moore
MONARCH PERSONNEL
28 East Jackson Blvd., Chicago 4, Ill.

PLANT ENGINEERS
Experienced on layout of all types of foundry equipment, material handling and material flows. Send complete details on work history, education and family status. Include recent photograph. All replies confidential. **Box F-140, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

FOUNDRYMEN
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Or if you are a FOUNDRYMAN looking for a new position you will want the advantages of this experience and close contact with employers throughout the country.
For action contact: John Cope
DRAKE PERSONNEL, INC.
29 E. Madison St., Chicago 2, Illinois
Financial 6-8700

POSITION WANTED

MANAGER-METALLURGIST with excellent foundry background and good management experience seeks opportunity with growing, progressive foundry. Experience includes foundry supervision and management, production control, quality control, purchasing, research, plus early trades training. Present earnings in low five figures. **Box F-110 P, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

MELTER-LABOR FOREMAN—Experienced in aluminum alloys to aircraft and missile specifications. Knowledge of basic metallurgy necessary to produce consistently high-quality melts. Supervised pouring and labor crew in medium-sized foundry. Presently employed. **Box F-105 P, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Got high scrap? Low Production? Sand Troubles? Want help? If you need a competent Superintendent-Manager, I can carry the load for you. Let's talk it over. **Box F-107 P, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

METALLURGICAL ENGINEER: B.S., M.S. in Met. Engr. Married, children, age 32. Six years experience in research, development and technical service mostly in castings and foundry supply field. Desires technical service and sales or production position. Will re-locate. Resume on request. **Box F-108 P, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

Chicago Area
GRAY IRON METALLURGIST, acid and basic cupola, practical and technical experience all phases foundry operation, age 50, available. **Reply to Box F-102 P, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

MANAGER-SUPERINTENDENT—Thirty years experience in steel, high alloy, iron, nodular and malleable. Age 51. Castings up to 20 tons. X-ray and magnaflux quality. Can produce at a profit. Good labor relations. Resume on request. **Box F-101 P, MODERN CASTINGS, Golf and Wolf Roads, Des Plaines, Ill.**

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The Editor's Forum . . .

Money and manhours are poured into industrial research and development today with a single goal—to open new markets. The difference between success and failure of an entire expansion program hinges on the constant search for new ways of using a process, product or new equipment. It is a sad comment that the foundry industry lags at the bottom of the list in spending R & D dollars. With industry as a whole plowing back over two per cent of the sales dollar for research, the foundry industry holds securely to last place with a 0.003 per cent expenditure.

It's been estimated that it takes eight years from the time research starts on a new material or process until it reaches commercial application. So you are already eight years behind competitive materials and processes—even if you start researching today.

Almost anything is possible, if a determined sustained program is maintained—witness the A-bomb and man-in-space projects. The foundrymen's needs are not so colossal but just as important to his future success. The only reason gray iron is not being die-cast today is because there hasn't been enough research effort and money spent on the project.

It has often been said: "If man can imagine it, it can be done." As proof, remember the Buck Rogers comics in the late 1920's and early 30's —an accurate preview of aerospace technology.

For too long a time, foundrymen have been willing to let industry suppliers carry the research ball. If it weren't for the yoeman efforts of these companies, foundries would still be ramming sand with the back of a shovel handle. They wouldn't have shell molds and cores, the CO_2 process, water-cooled cupolas, induction melting or any other modern foundry process or device.

Vendors have created new market opportunities for themselves and in turn for the metalcasting industry by developing new products and processes through research and then educating the foundrymen to use them properly.

It looks as though the progress of our foundry industry—past, present and future—is dependent on the ingenuity of our equipment builders and raw material suppliers. But you foundrymen must not continue to sit on your hands waiting for help. You should be seeking out new ways to improve your operations and call on the talents of vendors to assist you. A good example of this type of joint effort has just been demonstrated by the Pontiac Foundry of General Motors Corporation working with Quaker Oats Company to develop the new hot box furan core binder process.

Some encouragement may be gleaned from the first report of MODERN CASTINGS' Metalcasting Trends Panel. (See complete report page 45, May issue) Out of the total foundries represented on this panel, 68 per cent reported they already had metalcasting research facilities for developing new products, processes, or equipment. And 34 per cent had established theirs in the past five years. Many plan to expand their research capabilities during 1961.

At AFS, we are appalled at the small number of Castings Congress technical papers emanating from foundrymen each year. Of the 105 technical papers presented at the 1961 AFS Castings Congress last month, only 30 per cent of them came from foundries. Of the remainder, 30 per cent were the results of research sponsored by vendors, 8 per cent were prepared by castings buyers (your customers), and the remaining 32 per cent resulted from work done at universities, government laboratories, and research institutes.

Such apathy toward research must be overcome by leadership and initiative on the part of foundrymen to improve their operations. The demise of the railroad industry has more than once been blamed on their leaning too heavily on vendors to keep them competitive. As a start, foundrymen should at least begin to try to apply the new technology for profit.

And don't forget, foundries are also vendors —to the automotive, farm implement, machine tool, and many other industries. As a vendor are you helping these castings buyers improve their products? Probably not. Instead we again sit back and let our customers call the shots and develop the quality standards. It's time for foundrymen to provide the leadership instead of the followship.

Jack Hatcher

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